22 APR 1935

SURVEY OF INDIA

GENERAL REPORT

1934

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From 1st October 1933
To 30th September 1934

PUBLISHED BY ORDER OF

BRIGADIER H. J. COUCHMAN, D.S.O., M.C.

SURVEYOR GENERAL OF INDIA.

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Survey of India,
CALCUTTA,
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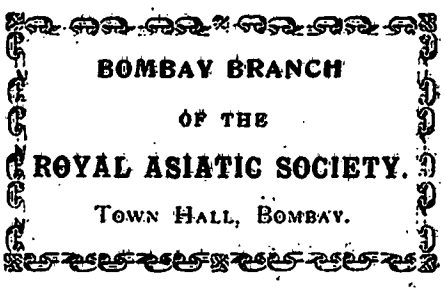

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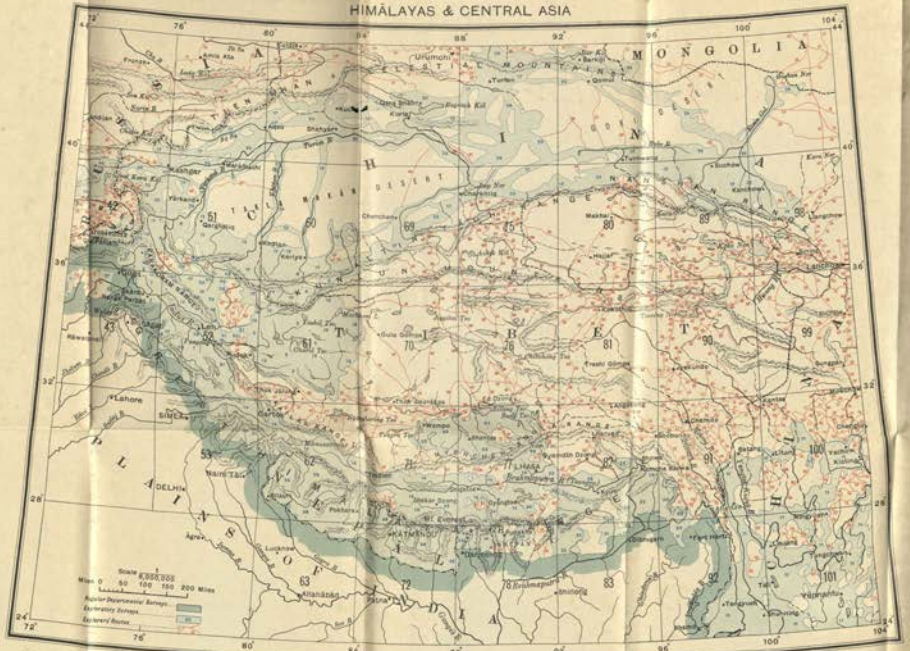
SURVEYS AND EXPLORATIONS

HIMÁLAYAS & CENTRAL ASIA



REFERENCES TO EXPLORERS' ROUTES

No.	Date of Journey or Publication	Explorer	Source
1		W. Moorcroft	1844-48
2	69	W.H. Johnson	1865
3	69,81,82,71	Nain Singh (Pundit)	1866-67
4	81,82	Kishen Singh (G.—K.)	1868
5	82	Mirza Shuja (The Mirza)	1868-69
6		T. Ivanhoff	1869
7	82	S.W. Fyfe(Capt.)	1871-72
8	82	Kishen Singh (A.—K.)	1872
9	82	Abu Mohammed (The Mullah)	1872-73
10	82	Abdul Subhan (W.—I.)	1873-74
11	81,82	Kishen Singh (A.—K.)	1873-74
12	69,70,71,77	Nain Singh (Pundit)	1873-75
13		Sonam Gay	1875
14	77	Lala Lal	1875-76
15	82	Abu Mohammed (The Mullah)	1876-78
16	82	Kishen Singh	1876-78
17		Ramaswami	1876-77
18		F.C. Bellasise	1876-77
19		A. Rogel	1877
20		W.J. Gill	1877
21	99	W. Osborne	1877
22	82	Mahbub Ali (W.—I.)	1878-80
23	82	Abdul Subhan (W.—I.)	1878-81
24	80,81,82,85, 99,100	N.M. Pyjnensky	1879-80
25	82	H. Michaelis	1879-81
26	72,80,81,82, 86,90,91,100	Kishen Singh (A.—K.)	1879-81
27	71	Sarat Chandra Das (Babu)	1879-82
28	82	A. Bonin	1882-83
29	82	Ismail	1882
30	82	Hrdlicka & Polaira	1883
31	100	A. Stoin	1883
32	77	Lama Ugi	1883
33	80,86,77,80, 86,90	N.M. Pyjnensky	1884-85
34	79	Sher Sing (W.—H)	1885-86
35	79	Kirsin Singh	1885-86
36	72,80,81,82, 86	A.D. Carey	1885-87
37	86	R. S. Hall	1887
38	82,83,91,92	F.E. Younghusband	1887-89
39	82,91	Dutreuil de Rhins	1889
40	80,82,91,96, 97	W.W. Rockhill	1889
41	100	G. Grijlenski	1889
42	73,76,81,82, 86	A. Bonvalot	1889-90
43	82	H.H.S. Littledale	1890
44	76,80,81,82, 86	W.N. Rockhill	1891-92
45	80,82,91,96, 97,73,75,77, 83,86,91	H. Rowe	1892-93
46	82,86,91,92, 93,94,95,97	J.L. Dutreuil de Rhins	1892-94
47	73,77,81,82, 86,96	H.G.H. Littledale	1893
48	80,86,96	Sven Hedin	1893-97
49	43,81,82,86, 90,96,97,98	H.H.S. Littledale	1895
50	73,76,81,82, 86,96,97	M.A. Wellby	1896
51	96,100	C. Boyle	1896
52	100	T.L. Bishop	1896
53	100	A. Stoin	1898
54	86,96	K. Futterer	1898-99
55	95,97,101	E. Deniker	1899-1900
56	96	Dr. Sapozhnikov	1900-1901
57	81,91,100,101	C.H.D. Sykes	1900-1901
58	80,86,91,96	F.E. Younghusband	1900-1901
59	80,86,96	A.N. Kamenskoff	1900-1901
60	82,81,86,91, 71,72,76, 77,96	Sven Hedin	1900-1908
61	101	S.L. Loch	1900
62	86,96,97	A.A. Ostrouhoff	1902
63	99,96,96	W. Filchner	1903-05
64	100	J. Barett	1904-10
65	96	C.D. Rose	1906
66	82,96,101	G. Clementi	1906-09
67	100	W.N. Ferguson	1906-07
68	82,91,93,75, 76,77	Sven Hedin	1906-08
69	101	C.C. White	1906-09
70	96,98	E. Nicholson	1907-08
71	100	J.E. Muir	1908
72	100	J.W. Brooke	1908
73	99,96	F.E. Kozloff	1908
74	98	G.S. Cooke	1910
75	100,101	W.N. Ferguson	1910
76	96	F.M. Bailey	1911
77		W.N. Ferguson	1911
78	80,91,100	C. Teichman	1916
79	96,100	H.R. Carlos	1916-17
80	101	F. Kingdon Ward	1921
81	82,86,91,96, 97,100,101	G. Pawlin	1921-23
82	98,101,102	L. King	1922
83	99,101	F.M. Bailey	1922
84	82	F. Kingdon Ward	1924
85	77,96	F. Kingdon Ward & Lord Cawdor	1924
86	80,91,96,100	C.E. Sowe	1925
87	99	J.F. Rock	1925
88	92,96,100	G. Thompson	1926
89	81,82,71,77, 81,90,97,99	W. Filchner	1926-28
90	82	W.R. Rickmers	1929
91	82	A. Stoin	1929
92	91	F. Kingdon Ward	1931
93	91	Ronald Kaulbach	1932

REFERENCES TO EXPLORATORY SURVEYS

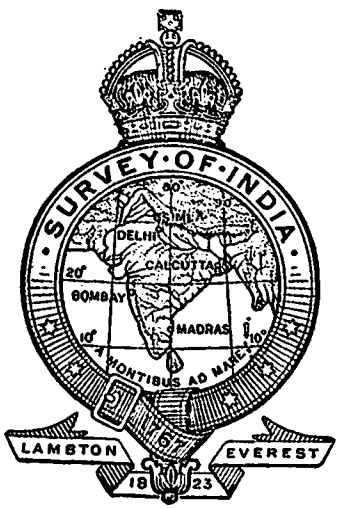
No.	Date of Survey or Publication	Explorer or Source	Scale	Scale of Publication
1	82,83	Survey of India	1849-1910	4 = 1 Deg.
2	82,83	Survey of India	1852-57	4 = 1 Deg.
3	82,83	Gopal Survey	1865-66	4 = 1 Deg.
4	82	Pundit Boundary Survey	1866	4 = 1 Deg.
5	82,91	H.H.P. Deasy	1896	1" = 4 m.
6	82	H.H.S. Littledale	1895	1" = 4 m.
7	82	Bracknell Pilot	1907-08	1" = 4 m.
8	82,91	H.H.P. Deasy	1907-09	1" = 4 m.
9	82	Ram	Ram Jung	1908	1" = 4 m.
10	82	Ist Singh	1909	1" = 4 m.
11	91,95, 100,101	T.H.D. Boyle	1910-11	1" = 4 m.
12	82,91,96	A. Stoin	1909-11	1" = 4 m.
13	73,91	Lama Kartlag & Abdul Wahab	1909	1" = 4 m.
14	82,92,71, 77,79	A.H. Macgregor	1910	1" = 4 m.
15	82	T.G. Longstaff	1909-07	1" = 4 m.
16	13,82, 82,91,96	Bullock Workman	1911 & 12	1" = 4 m.
17	82,73,76, 82,91,96	A. Stoin	1909-10	1" = 4 m.
18	73,82, 82,91,96	T.G. Longstaff	1909	1" = 4 m.
19	82	Duke of the Abruzzi	1911	1" = 4 m.
20	82,91,96	G.P. Gentry	1911-12	1" = 4 m.
21	82,91	A. Stoin	1911-12	1" = 4 m.
22	82,96	G.B.S. Traverse	1911-14	1" = 4 m.
23	82,91	A.L. Kitchener	1911-14	1" = 4 m.
24	82	Sella, Vittorio & Balla, Guido	1913	1" = 4 m.
25	82	E. Norin	1915	1" = 4 m.
26	77,91,92	H.T. Morshead	1915	1" = 4 m.
27	82	W.H. Wyn	1915-16	1" = 4 m.
28	71,72	F. de Filippi	1913-14	1" = Text & Atlas
29	82,91,92, 96,98,100	A. Stoin	1913-14	1" = 4 m.
30	82	Mason Valley & Tinglekundah Pilot Survey	1914 (Map)	
31	82	Lahore Exam	1920	1" = 4 m.
32	73,75,76	H.T. Morshead & R.G. Wicher	1920	1" = 4 m.
33	71,72,82	H.T. Morshead	1922	1" = 4 m.
34	71,72	F.M. Bailey	1913	1" = 4 m.
35		R.E.C. Maude	1922	1" = 4 m.
36	82,91	C.G. Stevens	1922-24	1" = 4 m.
37	82	Khushal Khan	1924	1" = 4 m.
38	82	H.T. Morshead	1924	1" = 4 m.
39	82,95, 71,72	Nepal Survey Department	1924-27	1" = 4 m.
40	82	A. Stoin	1925	1" = 4 m.
41	82	E. Norin	1925	1" = 4 m.
42	82	E. Trinkler	1927	1" = 4 m. 1:500,000
43	82	H.F. Montgomery	1927	1" = 4m. 1:2,000,000
44	82	W.R. Rickmers	1928	
45	82	Diary of Sotnik	1928	
46	82	H.G. Vivian	1928	
47	82,96	A. Stoin	1928	1" = 4 m.
48	82	G. Trinkler	1929	1" = 4 m.
49	82	Paul Bauer	1931	1" = 4 m.
50	82	E. St. J. Birnie	1931	1" = 4 m.
51	82	H. de Terra	1932	1" = 4 m.
52	100	E.L. Bradford & A.R. Emerson	1932	1" = 4 m.

Survey of India Office 1934

SURVEY OF INDIA

GENERAL REPORT

1934



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PREFACE

THE HISTORY AND WORK OF THE SURVEY OF INDIA.

The first authoritative map of India was published by D'Anville in 1752, when the exploration of the then unknown India was still largely in French hands. It had been compiled from routes of solitary travellers and rough charts of the coast.

The Survey of India may be said to have been founded in 1767—ten years after the battle of Plassey—when Lord Clive formally appointed Major James Rennell the first Surveyor General of Bengal, at that time the most important of the East India Company's possessions, though there were earlier settlements in Madras and Bombay.

Rennell's maps were originally military reconnaissances and latterly chained surveys based on astronomically fixed points, and do not pretend to the accuracy of modern maps of India based on the rigid system of triangulation commenced at Madras in 1802 and since extended over and beyond India. Even now however the *relative* accuracy of these old maps makes them valuable in legal disputes, as for instance in proving that the holding of a Bengal landowner was a river area at the time of the Permanent Settlement of 1793, so that he is debarred from its benefits.

From these beginnings, this department has gradually become primarily responsible for all topographical surveys, explorations and the maintenance of geographical maps of the greater part of Southern Asia, and also for geodetic work.

Geodesy means the investigation of the size, shape and structure of the earth, and the geodetic work of the department consists of primary (or geodetic) triangulation, latitude, longitude and gravity determinations. From these the exact "figure" of the earth is obtained, whereby points fixed by triangulation can be accurately located on its curved surface. This system of fixed points holds together all topographical and revenue surveys, and the existence of such a system from the early days of the department has avoided the embarrassments caused in other countries where isolated topographical surveys have been started without a rigid framework, with the inevitable result that they could not be fitted together.

A geodetic framework is therefore essential in any large survey, but there are a number of other activities, all of these ultimately utilitarian, which can be suitably combined with it and the following are some of those which have been carried out in India:

Precise levelling for the determination of heights;
Tidal predictions and publication of Tide Tables for forty ports between Suez and Singapore;
The Magnetic survey;
Observation of the direction and force of gravity;
Astronomical observations to determine latitude, longitude and time;
Seismographic and meterological observations at Dehra Dūn.

Indian geodesy has disclosed by far the largest known anomalies of gravitational attraction in the earth's crust, which have recently led to a reconsideration of the whole theory of isostasy.

Topographical Surveys.—In the past this department used to carry out the large scale revenue surveys for most of India, and was still conducting this work for Central and Eastern India and Burma in 1905.

Though revenue survey is primarily a record of individual property boundaries and is unconcerned with the surface features, ground levels and exact geographical position essential to a topographical survey, it was on the whole found economical to carry out both surveys together.

By 1905 however, the small scale topographical surveys compiled from the large scale revenue maps had fallen seriously in arrear, owing to the relatively slower pace and incompleteness of the latter, on which "waste" non-revenue-paying areas are normally shown blank.

An authoritative Survey Committee appointed by the Government of India considered the position in 1905. It was feared that a separation of the topographical and revenue surveys might result in a wasteful duplication of work and two overlapping but mutually discrepant systems of mapping. These objections were met by a ruling that the basis of both systems of survey should be identical and provided either by the Survey of India or under its supervision.

Subject to this principle, the remaining revenue surveys were handed over to the provinces, who had always paid for them as part of the overhead charges of revenue collection, and the Survey of India was enabled to concentrate its energies on a complete new series of modern topographical maps in several colours on the 1-inch to 1-mile scale.

This new series had been rendered necessary by the natural demand for more detailed information to be shown on maps, especially as regards the portrayal of hill features by contours, proper classification of communications and—more recently—air traffic requirements.

It was intended that this 1905 survey should be completed in twenty five years, and then revised periodically every thirty years. Owing however to the war and more recent retrenchments, only two thirds of the programme had been completed by 1932, in spite of the reduction of scale for the less important areas.

Although new surveys are carried out every year, covering from thirty to sixty thousand square miles—an area roughly that of England—the maps of a large part of the country are still over 50 years old, printed mostly in black only, and have hill features shewn by roughly sketched form lines or hachures; such changes in town sites, canals and communications as have been embodied in them have not been surveyed on the ground, but are entered from data gathered from outside sources.

Owing to the serious financial situation in 1931, the establishment of the department was severely cut down and its annual expenditure halved, in consequence of which the modern survey of India cannot now be completed before 1950.

The obsolescence of the present series of modern maps of India is shewn in the second index map at the end of this report.

Large Scale Surveys.—Surveys and records of international, state and provincial boundaries have always formed an important item of topographical work, and in recent years numerous Guide Maps have been published of important cities and military stations where the 1-inch to 1-mile scale is inadequate.

Miscellaneous.—While expending on topographical and geodetic work all funds allotted by imperial revenues, the department is prepared to undertake or aid local surveys, on payment by those concerned, such as

Forest and cantonment surveys;

Riverain, irrigation, railway and city surveys;

Surveys of tea gardens and mining areas, with such control levelling as is necessary for these operations.

Administrative assistance is also given, and executive officers lent, in aid of the revenue surveys of various provinces and states.

The Printing Offices at Calcutta and Dehra Dūn are always at the disposal of other Government departments, for such work as the printing of special maps, illustrations for reports and all diagrams for patents.

The Mathematical Instrument Office of this department assists all Government departments, as well as non-officials, by maintaining up-to-date instrumental and optical equipment and by manufacturing and repairing instruments which would otherwise have to be replaced from abroad.

Military Requirements and Air Survey.—The Department is also responsible for all survey operations required by the army, and is in a position to meet the rapidly increasing complexity of modern military requirements, especially in air survey.

In view of its high military importance, air survey work for civil purposes is receiving all possible assistance, and continuous research is being carried on in the latest methods of mapping from photographs taken from the ground and in the air.

The flying and photography for air mapping done by this department are at present carried out by the Royal Air Force or the Indian Air Survey Company, a commercial firm with headquarters at Dum Dum.

Administration is in the hands of the Surveyor General under the Education, Health and Lands Department of the Government of India.

The Headquarters Office is at Calcutta under the Assistant Surveyor General, and there are four Directors, one for the Map Publication and other technical offices at Calcutta, and three for three of the five Survey of India Circles into which the country is divided; the other two Circle areas (covering Burma and South India) are administered personally by the Surveyor General.

Of the three Circle Directors, one also administers the Geodetic Branch at Dehra Dūn in addition to his topographical survey Circle.

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4. ,, ,, ,, ¼-inch scale ... ... ,,
5. India and Adjacent Countries Series, 1/M scale ,,
6. Carte Internationale, 1/M scale ... ... ,,
7. Southern Asia Series, 1/2M scale ... ... ,,

Coloured Spectacles for viewing anaglyphs ... ... in pocket in back cover.

GLOSSARY.

Scales are referred to as follows:—

(*i*) by their representative fraction, *e.g.* "1/25,000",

(*ii*) *for scales which are multiples of 1/1,000,000*—"1/M scale", "1/6M scale" &c., which mean "1/1,000,000 scale", "1/6,000,000 scale" &c.;

(*iii*) *for scales smaller than 4 miles to one inch*—"50-mile scale", "8-mile scale" &c., which mean "scale of 50 miles to one inch" "scale of 8 miles to one inch" &c.,

(*iv*) *for scales of and larger than 4 miles to one inch*—"¼-inch scale", "½-inch scale", "4-inch scale", "16-inch scale" &c., which mean "scale of ¼ inch to one mile" &c., &c.

Serial numbering of Survey of India maps. The system of numbering will be evident by a reference to the Indexes at the end of this report, *e.g.*

Sheets 65, 78 &c. are sheets on the 1/M scale;

Sheets 65K, 78F &c. are ¼-inch sheets;

Sheets 65K/N.W., 78F/S.E., &c. are ½-inch sheets;

Sheets 65K/1, 78F/16 &c. are 1-inch sheets.

Abbreviations.—U. S. S. denotes Upper Subordinate Service.

L. S. S. denotes Lower Subordinate Service.

U. S. Officer denotes Upper Subordinate Officer.

L. S. Officer denotes Lower Subordinate Officer.

P. L. O. denotes Photo.-Litho. Office (Calcutta).

P. Z. Section denotes Photo.-Zinco Section (Dehra Dūn).

D. O. denotes Drawing Office.

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INTRODUCTION AND SUMMARY.

1. **Annual Reports** are published, with effect from the report of 1933, in two separate volumes as follows :—

Geodetic Report.

General Report.

Both of these reports are for the survey year ending 30th September, with the exception of *Part 4* of the *General Report* (Map Publication and Office Work) which is for the financial year up to 31st March.

The Geodetic Report includes full details of all scientific work.

The General Report only gives brief abstracts of the *Geodetic Report* (*vide Part 2* in the Table of Contents), but gives complete reports of the survey operations of the ordinary field parties and detachments. Abstracts II and IV (*vide* Table of Contents) summarize these latter reports and enable the reader to look up such portions as may interest him.

The first Index Map appearing at the end of this Report shows the progress of modern topographical surveys and compilation. Maps of sorts are of course available for all parts of the Indian Empire, but some of them are very old, and all maps previous to 1905 were based on the old longitude of 1815 (which was over 2 miles out) and are therefore excluded from the Index Map.

Part 4 (Map Publication and Office Work), with the last five INDEX MAPS at the end of this report, shows the progress of map publication on all scales, and contains reports on publication and issues, printing and drawing, and of such offices as the Mathematical Instrument Office, which have to conform with the financial year.

The obsolescence of the modern maps of India is shown in the second Index Map at the end.

2. **General.** Brigadier H. J. Couchman, D.S.O., M.C., held the post of Surveyor General throughout the year.

The post of Assistant Surveyor General was filled by Major H. R. C. Meade, I.A., throughout the year.

3. The total cost of the Department for the year ending 31st March 1934, as compared with that of previous years, was as follows:—

	1931-32	1932-33	1933-34	REMARKS.
	Rs.	*Rs.*	*Rs.*	
Gross actual cost ...	49,86,863(*a*)	36,10,206(*b*)	33,17,073 †	(*a*) Including Rs. 1,80,750 for English Charges (High Commissioner) on Stores, and loss or gain by exchange. (*b*) Including Rs. 1,21,330 for do. do.
Deduct recoveries ...	14,50,965	14,08,175	12,55,341 †	
Nett actual charges ...	35,35,898	22,02,031	20,61,732 †	† These figures are not final.
Total area of survey of all kinds completed during the year.	Square miles.	Square miles.	Square miles.	
	37,924*	43,683*	42,216*	* *Vide* page 16.

4. Organisation. The retrenched organisation introduced in 1932 remained in force during the year under report.

A scheme has been sanctioned for the partial Indianization of the military portion of the Class I Service of the Survey of India. One quarter of this portion will be reserved for Indian Officers holding the King's Commission, the remainder being Royal Engineer Officers.

The long connection of British Officers of the Indian Army with the Survey of India, which has lasted for over 160 years, will not however be terminated, since the scheme provides for the appointment of these officers whenever qualified candidates of the other two categories are not forthcoming.

The Government of India have decided to extend the principle of communal representation to the technical appointments in the Survey of India, General Services, Class I and Class II.

Direct recruitment for Class II Service of the Survey of India will, in future, be made through the Public Services Commission.

The services of Mr. C. B. Sexton, Extra-Assistant Superintendent of the Survey of India were permanently transferred to the Bengal Government with effect from the 23rd August.

Mr. H. H. Creed, whose services were transferred to the Government of Assam from the 1st May 1933 and who was appointed by them on probation for one year, has been confirmed in his appointment under that Government from the 18th April 1934, and ceases to have any lien on his appointment in the Survey of India.

5. Notable events of the Survey year.

Colonel R. H. Phillimore, D.S.O., is preparing a series of Record Volumes dealing with the early history of the Survey of India, and for this purpose the more interesting of the early correspondence and original records of the Department are being collected and arranged in Dehra Dūn.

A detachment of No. 15 Party consisting of 4 Upper Subordinate Officers and 17 Lower Subordinates under Mr. N. N. Chuckerbutty, L.C.E., ran lines of levels in the Bihār earthquake area during March, April and May, from which the local authorities hoped to predict monsoon flooding. 2,300 miles of levelling were completed, and lists of heights of the 23,000 points fixed and 1-inch maps showing the lines levelled, were delivered to the Government of Bihār and Orissa on 31st May.

The Governor in Council expressed his thanks for the prompt and efficient manner in which the levelling was initiated and carried through. (para. 114).

Boundary Survey.—

TRIPURA STATE BOUNDARY.—Mr. K. L. Dhawan and two surveyors surveyed 8 square miles on the 1-inch scale in connection with demarcation of the Tripura State boundary adjoining the Lushai Hills and Chittagong Hill Tracts. (para. 95).

The Superintendent, Lushai Hills, in a letter of appreciation of the work on the boundary, which enabled a clear and speedy settlement to be obtained, states:—

"My note to you would not be complete if I did not tell you how very helpful and quietly efficient Mr. Dhawan was in placing the technical survey details before us, and I was greatly impressed by his tact and the unstinted and willing assistance he gave us".

THE KOHĀT CANTONMENT BOUNDARY, 9·1 linear miles in length, was traversed on payment by 'A' Company. This boundary was not completely demarcated at the time of the survey of the Cantonment in 1923—24.

Exploration.—

An index showing exploration surveys and routes beyond the Indian frontier in Central Asia appears at the beginning of this report.

The results of route surveys carried out in 1926—28 in China and Tibet by Dr. Wilhelm Filchner, the German explorer, were received and are being incorporated in a new edition of the 1/2,500,000 map of the Himālayas and Central Asia.

Dr. Filchner arrived at Dehra Dūn on the 29th September and left on the 14th October. While in Dehra Dūn he made comparisons

of his magnetic instruments and also occasionally helped with the compilation of a part of his Tibet work, which is being utilized by the Department.

The period of deputation of Surveyor Muhammad Ayub Khan, who accompanied Sir Aurel Stein in November 1931 in connection with his explorations in the Punjab and South Persia, was further extended. He reverted to duty in the Department on 28th June.

The route surveys carried out in South-East Tibet by Captain Kingdon Ward and Mr. Ronald Kaulback during 1933-34 are being incorporated in the sheets of that area.

An area of some seventy square miles was compiled by the Geographical Section, War Office, London, from the vertical air photographs taken by the Everest Flight in April 1933. A portion of this is being utilized in the compilation of sheet 72.

Air Survey.—

The 1st edition of Chap. XII of the Handbook of Topography Air Survey, compiled by Capt. D. R. Crone, R.E., was published.

During the year the method of surveying from oblique photographs (described in Appendix I of the General Report for 1931-32) was extended by No. 18 (Air Survey) Party to dispense with the visible horizon and research work in this connection was carried out (para. 58).

The north face of Nanga Parbat (26,660 ft.) was mapped by this method on the 1/100,000 scale and the resulting map supplied to Herr Willy Merkl, the leader of the 1934 German Nanga Parbat expedition (para. 58).

Tests were made on a 6 inch lens lent by Messrs. Ross Ltd. for experimental work in the F/8 camera (para. 59).

As a result of the experiment described in paras. 5 and 56 of the 1933 General Report, 1386 square miles of a heavily wooded low-lying portion of Tripura State was successfully surveyed by a combination of air and ground-survey methods (paras. 57 and 95).

Deputation of Officers.—

Mr. B. B. Shome, S. A. Superintendent, was temporarily deputed under the Central Provinces Government from 21st December to 10th April as officiating Survey Officer, Central Provinces.

Lectures.—

Colonel Hamilton, D.S.O., delivered a lecture on "Surveys in War—the tactical aspect" to the Senior Class of the Staff College Quetta on the 5th March.

The members of the Mining and Geological Institute of India, Calcutta, visited the Headquarters Offices, Calcutta on the 22nd January, and Lt. Colonel King, R.E., Director, Map Publication, delivered a lecture on "Map Production" to them in the hall of the Asiatic Society of Bengal, Calcutta, on the 27th July.

The officers attending the Western Command Intelligence Course visited the office of "E" Company at Quetta on the 7th July. After

a short lecture by the Officer Commanding, "E" Company, they went round the drawing office and reproduction and stores sections.

The students of the Junior Division of the Staff College attended a lecture and demonstration in the office of "E" Compny at Quetta on the 25th July.

Adventures and Casualties.—

The Surveyor General deeply regrets to record the following deaths:—

Rai Chuni Lal De Bahadur, late Registrar, who died at Calcutta on the 22nd March.

Sub-Assistant Surgeon Jemadar Ram Rattan, I.M.D., No. 2139, attached to No. 12 Party, who died in the field on the 23rd February as a result of heart failure following high fever. The death occurred on the Manu river at Jinajini, 25 miles from Kailāshahar (Tripura State), while the Sub-Assistant Surgeon was on his way to the latter place.

Rai Jagdamba Prasad Bahadur, late Deputy Superintendent, Survey of India, who died at Lucknow on the 11th June, enlisted as a Lower Subordinate in 1891 and was the first Indian to be promoted to Class I, in 1922, three years before his retirement.

Jemadar Hari Ram and Tindal Ram Charan of No. 20 Detachment, who were murdered on the 3rd May on the premises of the Forest Rangers College, Dehra Dūn.

A huge rogue elephant, probably the same one that raided the camp of the Director Eastern Circle last year (paras. 5 and 91 of 1933 General Report), was shot by Officer in Charge, No. 12 Party, in Tripura State. This elephant measured 10 ft. 4 inches at the shoulder, which equals the record for a *makhna*.

10 Lower Subordinates and 11 inferior servants died during the year under report.

Distinguished visitors.—

Mr. Ram Chandra, C.I.E., M.B.E., I.C.S., Joint Secretary to the Government of India, Department of Education, Health and Lands, visited the Headquarters Offices of the Survey of India in Calcutta on the 22nd March.

Captain F. C. W. Fosbery, R.E., of the General Staff, A. H. Q., India, visited the Photo.-Zinco. Office at Dehra Dūn, where Army Section personnel were being trained in litho printing.

Lt.-Colonel H. E. Roome, M.C., R.E., officiating Chief Engineer, Southern Command, visited the office of No. 6 Party on the 12th June.

The following officers visited the Survey of India Offices in Murree during the year:—

The Northern Command Annual Intelligence Class, to whom the methods of air survey and reproduction processes were demonstrated.

Brigadier A. K. Hay, D.S.O., O.B.E., Brigadier General Staff, and Major C. M. P. Durnford, I.A., G. S. O. II, Northern Command.

Major General S. F. Muspratt, C.B., C.S.I., C.I.E., D.S.O., General Officer Commanding Peshāwar District and Brigadier D. K. Mcleod, D.S.O., Commander, 1st (Risālpur) Cavalry Brigade.

The Officers of the 6th Liaison Course for the Army in India, held under the auspices of the Royal Air Force, visited the office of 'E' Company at Quetta and were given a demonstration of map production.

6. Appreciations and Awards.

His Imperial Majesty the King, Emperor of India, has been graciously pleased to appoint Brigadier R. H. Thomas, D.S.O., lately Surveyor General of India, to be a Companion of the Most Exalted Order of the Star of India.

The title of 'Rai Sahib' was conferred on Computer Gulab Singh, who had been on foreign service with the Government of 'Irāq since 1924, as a personal distinction.

The evolution of the plane-table is described on page 164 of Hinks' "Maps and Survey" (3rd Edition 1933) as follows :—

"The discovery of the right use of the plane-table is of comparatively modern date, and its credit belongs to the Survey of India. The instrument itself is ancient; but so long as it was employed only for fixing points by intersection, or so long as it was set up by compass, and resections were made by two rays only, it was not a very valuable instrument. The introduction of the method of resection by the solution of the triangle of error made it at once an instrument of precision, unexcelled for convenience and rapidity of work."

Dr. Richard Finsterwalder and Dr. Walter Raechl, on their return from the German Nanga Parbat expedition, visited the Geodetic Branch Offices on the 30th August.

Dr. Finsterwalder wrote to the Director, Geodetic Branch, expressing his appreciation of the kind reception accorded to him during his visit and stating:—

> "What we have seen there was not only of great interest but "also of great value for us, and we have got a deep impression "of all that British geodesists have done in India.
>
> "I shall send you any publication written by me about "our geodetic work of the expedition and hope that our results "may be of some value for the Survey which has given us "such important help".

The expedition carried out the field work of a photogrammetric survey of the whole of the Nanga Parbat massif and also took observations for the meridional component of vertical deflection at various stations in the neighbourhood of the mountain.

The following demi-official letter was written by H. B. M. Minister, Tehrān, on the 8th September 1932 to the Foreign and Political Department, regarding the Perso-Baluch Boundary Survey described in para. 5 of the 1931-32 General Report :—

> "I have read with the greatest interest the report by Bomford, "which accompanied his map of the Baluchistān frontier. He

"has done a pretty piece of work in a short space of time and "I think he is to be congratulated both on his map and, so far "as I can judge at present, on his conclusions.
"If you have no objection I should be very glad if you would "tell him how much I admire his work which throws a blaze of "light on the problem presented by the frontier".

Mathematical Instrument Office.—

The following officers visited the Mathematical Instrument Office Calcutta during the year:—

Lt.-General Sir H. E. ap Rhys Pryce, K.C.B, C.M.G., D.S.O., Master General of the Ordnance, Bt.-Lt.-Colonel J. N. Thompson, D.S.O., M.C., R.A., Assistant Master General of the Ordnance and Colonel R. Crofton, M.C., I.A.O.C., Assistant Director of Artillery, with the Inspector of Guns, Cossipore, and Assistant Inspector of Guns, Hastings, visited the Mathematical Instrument Office, on the 12th April and discussed with the Director, Map Publication, and Superintendent, Mathematical Instrument Office, the question relating to the amount of work the Army are prepared to send to that office annually.

Major Suggate, Ordnance Mechanical Engineer, Allāhabād Arsenal.

Major Bloor of Rāwalpindi Arsenal.

Lt.-Col. R. Crofton, M.C., I.A.O.C., Assistant Director of Artillery, M. G. O. Branch, Army Headquarters.

The members of the Ordnance Mechanical Engineers' Conference.

Major F. J. Rice, M.C., R.A., Deputy Assistant Director of Artillery M. G. O. Branch, Army Headquarters, Simla.

Among other special manufactures were the following:—

Two sounding chains, 60 feet, supplied to the Engineer-in-Chief, Vizagapatam Harbour Construction.

Three callipers duralumin (one 14″ and two 26″) supplied to the Silviculturist, Forest Research Institute, Dehra Dūn, who thanked the Superintendent, Mathematical Instrument Office, for the interest taken in modifying the instruments to his needs.

Two Waterfinders for the Customs Department, Calcutta.

One Apparatus for testing aneroid barometers, for the Inspector of Guns, Cossipore.

Seven ampoule fillers, new pattern, supplied to the Director, Bacteriophage Laboratory, Bihār and Orissa, Bankipore.

One Ampoule Filler of an improved design supplied to the Director, School of Tropical Medicine, Calcutta.

Four Magnets, Polar (Polarity Indicators) supplied to the Superintendent, Gun and Shell Factory, Cossipore.

7. Personnel.—Casualties, retirements, promotions and other changes were as follows:—

Class I Officers.—Major R. S. Wauchope, O.B.E., I.A., was granted leave preparatory to retirement.

Brigadier R. H. Thomas, C.S.I., D.S.O., Colonel R. H. Phillimore, D.S.O., Lt.-Col. L. G. Crosthwait, I.A., Lt.-Col. R. Foster, I.A., Lt.-Col. Kenneth Mason, M.C., R.E. and Mr. E. B. West, retired.

Colonel H. J. Couchman, D.S.O., M.C., confirmed as Surveyor General and granted the temporary rank of Brigadier.

Lt.-Colonels F. J. M. King, R.E. and C. G. Lewis, O.B.E., R.E., confirmed as Directors.

Mr. D. K. Rennick, M.B.E., confirmed as Superintendent.

Lt.-Col. C. G. Lewis, O.B.E., R.E., promoted to be Colonel.

Majors E. O. Wheeler, M.C., R.E., and O. Slater, M.C., R.E., promoted to be Lt.-Colonels.

Captain G. W. Gemmell, I.A., promoted to be Major.

Lt. I. H. R. Wilson, R.E., promoted to be Captain.

Lt. J. S. O. Jelly, R.E., confirmed as Assistant Superintendent.

Lts. C. A. Biddle, R.E., and D. E. O. Thackwell, R.E., joined the Department as Assistant Superintendents (on probation).

Class II Officers.—Messrs. A. M. Talati, L.C.E., A. B. Hunter, E. M. Kenny, P. N. Sur, L. B. Fitz-Gibbon, H. T. Hughes, G. A. Norman, M.B.E., M. S. G. Aiyar, A. J. Booth, M.B.E., S. R. Kelkar, B.Sc., and S. R. Gupta, B.A. retired.

Messrs. C. B. Sexton and H. H. Creed were permanently transferred to the Governments of Bengal and Assam respectively.

Mr. R. N. Hastir, has been promoted from the Upper Subordinate Service to Class II.

Seven probationers were appointed.

Miscellaneous appointments.—Mr. R. J. Mendieta, Registrar retired and Mr. N. N. Banarji was confirmed as Registrar.

Jemadar Ram Ratan, I.M.D. died in the field.

Upper Subordinate Officers.—Messrs. S. C. Mukherjee, D. R. Vohra, Raizada Bhamba Ram, C.H., Abdul Majid, D. S. Gandhi, Abdul Karim, I, Iltifat Hossain, C.H., Ahmadullah Khan, R. C. Ray, D. M. Das, S. N. Mitra, M.R.A.S., T. N. Sharma, B.A., Muhammad Kudratullah Khan, R. K. Bhattacharji, B.A., K. N. Joardar, B.A. and Hakdad Khan retired.

Three probationers were confirmed.

II.—ABSTRACT OF SURVEYS IN EACH PROVINCE AND STATE.

8. The prime duties of the Survey of India are geodetic, topographical and geographical, but the department is also developing co-operation with local survey agencies, with a view to mutual economy, and is now doing a considerable amount of miscellaneous outside work on payment, besides advising and assisting Provincial Governments with local and settlement surveys as required.

The following abstract shows the nature and *locale* of the field operations actually carried out by the Department during the past year, grouped under the following sub-heads:

Air Surveys.	Riverain Surveys.
Exploration.	Boundary Surveys.
Topographical Surveys.	Geodetic.
Forest Surveys.	Framework.
Cantonment and City Surveys.	Levelling.
Cadastral Surveys.	Miscellaneous.
Railway Surveys.	Training.

9. N. W. F. Province and Kashmīr.

Air surveys in Tribal Territory (Black Mountain) and Gilgit Agency (p. 34).

Correction surveys in Bannu, Dera Ismaīl Khān and Kohāt districts (p. 30).

10. Baluchistān.

Topographical surveys in Quetta-Pishīn district and in Kalāt State (p. 32).

Geodetic. Measurement of a base and its connection to primary triangulation near Dālbandin (p. 14).

11. Punjab, Punjab States and Delhi.

Topographical surveys in Delhi Province, in Ferozepore, Hissār, Kāngra, Lahore, Montgomery, Multān, Muzaffargarh and Rohtak districts and in Bahāwalpur, Dujāna, Farīdkot and Jīnd States (pp. 30, 36) and in Patiāla State (p. 37).

Correction surveys in Attock, Miānwāli and Shāhpur districts (p. 30).

Levelling. Tertiary levelling in Delhi Province, Hissār and Rohtak districts and Dujāna and Jīnd States (p. 36).

12. Rājputāna and Ajmer-Merwāra.

Topographical surveys in Ajmer-Merwāra Province and in Jaipur, Jodhpur, Kishangarh, Shāhpura, Sirohi and Udaipur States (p. 37); also in Bikaner State (p. 30).

Framework. Triangulation in Jodhpur, Pālanpur, Sirohi, Tonk and Udaipur States (p. 38).

Traverse in Bikaner State (p. 30).

13. Central India and Gwalior.

Topographical surveys in Bhopāl, Dewās (Senior and Junior), Gwalior, Indore, Khilchipur, Narsinghgarh and Rājgarh States (p. 37).

Framework. Triangulation in Gwalior and Indore States (p. 38).

14. United Provinces.

Topographical surveys in Ballia district (p. 41).
Cantonment surveys. Re-survey of Allahābād, Fyzābād and Shāhjahānpur Cantonments (p. 38).
Framework. Traversing for cantonment survey of Dehra Dūn (p. 38).
Levelling for cantonment survey of Dehra Dūn (p. 38).

15. Central Provinces.

Topographical surveys in Bhandāra, Chānda, Drug and Raipur districts (p. 43).
Forest surveys. Some reserved forests in Drug district were included in the areas of topographical survey (p. 43).
Framework. Triangulation and traverse in Raipur district (p. 43).

16. Bombay Presidency.

Topographical surveys in Karāchi district (p. 32).
Geodetic. Measurement of a base and its connection to primary triangulation at Poona (p. 14).
Gravity at 14 stations (p. 13).

17. Hyderābād, Deccan States and Kolhāpur Residency.

Geodetic. Gravity at 1 station (p. 13).
Latitude at 4 stations (p. 13).

18. Mysore and Coorg.

Geodetic. Latitude at 4 stations (p. 13).
Gravity at 6 stations (p. 13).

19. Madras Presidency and Madras States.

Topographical surveys in Ganjām and Vizagapatam districts (p. 48).
Geodetic. Gravity at 20 stations (p. 13).
Latitude at 30 stations (p. 13).
Longitude at 2 stations (p. 13).
Framework. Triangulation in Ganjām and Vizagapatam districts (p. 48).

20. Eastern States.

Topographical surveys in Bāmra, Kānker, Khairāgarh, Nāndgaon, and Rairākhol States (pp. 41, 43).
Boundary surveys between Khairāgarh and Chhuikhadān States (p. 43).
Framework. Triangulation in Bastar and Kālāhandi States (p. 48).
Traverse in Bastar and Kānker States (p. 43).

21. Bihār and Orissa.

Topographical surveys in Gaya, Hazāribāgh, Patna, Sambalpur, Sāran and Shāhābād districts (p. 41).
Geodetic. Longitude at 4 stations (p. 13).
Framework. Traverse in Darbhanga, Monghyr, Muzaffarpur and Patna districts (p. 41).
Levelling. Secondary and tertiary levelling in connection with the earthquake of January 1934 (p. 51).

22. Bengal Presidency and Sikkim.

Air Surveys in Chittagong Hill Tracts and Noākhāli district and in Tripura State (p.p. 44, 45).
Topographical surveys in Chittagong Hill Tracts and Tripura State (p. 44).

Boundary surveys between Lushai Hills district and Tripura State (p. 44).

Geodetic. Longitude at 28 stations (p. 13).

Framework. Traversing for cantonment surveys of Barrackpore and Ishāpur (p. 38).

Triangulation in Chittagong district (p. 50).

Levelling for cantonment surveys of Barrackpore and Ishāpur (p. 38).

23. Assam and Bhutān.

Topographical surveys in Lushai Hills district (pp. 46, 50) and in Manipur State (p. 49).

Boundary surveys. Between Lushai Hills district & Tripura State (p. 44).

Geodetic. Measurement of a base near Sibsāgar, and its connection to primary triangulation (p. 14).

Reconnaissance and building stations for a Primary series on the south side of the Assam Valley (p. 14).

Longitude at 3 stations (p. 13).

Framework. Triangulation in Lushai Hills district (p. 50).

24. Burma.

Topographical surveys in the Upper and Lower Chindwin, Chin Hills, Pakokku and Shwebo districts (p. 49).

Framework. Triangulation in the Akyab, Arakan Hill Tracts, Chin Hills and Minbu districts (pp. 50, 51).

Levelling. High Precision Levelling from Kengtung to the Siamese frontier (p. 14).

Levelling of Precision from Mandalay to Lashio.

Secondary levelling for the Public Works Department in the area disturbed by the Pegu earthquake of 1930 (p. 51).

25. Ceylon, Maldive and Laccadive Islands.

Geodetic. Gravity at 30 stations (p. 13).

Latitude at 5 stations (p. 13).

Longitude at 5 stations (p. 13).

PART 2.—GEODETIC WORK.

III.—ABSTRACT OF GEODETIC OPERATIONS.

DIRECTOR:— Colonel R. H. Phillimore, D.S.O., to 18-2-34.
Colonel C. G. Lewis, O.B.E., from 19-2-34 to 21-6-34.
Lt.-Colonel C. M. Thompson, I.A., from 22-6-34.

26. General.—Besides geodetic work, the Director, Geodetic Branch, administers at Dehra Dūn *No. 2 Drawing Office*, the *Forest Map Office*, a *Printing Section* and a *Photo.-Zinco. Section*, whose work is reported in *Part 4* of this report, and also the following survey operations, which are reported in other parts of the General Report:—

Levelling carried out in aid of special engineering projects, (paras. 113-114).

Topographical Survey carried out by No. 1 Party (paras. 67-70).

Cantonment Surveys (paras. 71-75).

Training School (para. 115).

27. Geodetic.—Purely geodetic operations include miscellaneous computations and research, preparation and publication of records, observatory work (astronomical, magnetic, seismological and meteorological), the measurement of geodetic bases, principal triangulation, geodetic levelling, precise latitudes, longitudes, azimuths, and gravity determinations in all parts of India, and prediction of tides at 41 eastern ports between Suez and Singapore.

These operations are fully described in the annual Geodetic Report of the Survey of India. The following is a brief abstract of the geodetic operations described in the Geodetic Report of 1934, which contains complete index maps and detailed results.

28. Observatory Section.—Bi-weekly time observations were continued satisfactorily with Dr. Hunter's shutter transit and with the motor transit, and a record of the longitude of Dehra Dūn was maintained by the reception of wireless time signals from Bordeaux and Rugby.

The International Longitude programme was observed during October and November. Three transit instruments were used, and four observers took part. All the instruments gave accordant results with each of the 4 observers, but the three instruments showed a range of 0·15 seconds among themselves.

Shortt Clock No. 34 was in use throughout the year.

The invar base-line wires were standardized five times. The metre and 4-metre standards were compared with each other and were found to have maintained their lengths well since 1930.

The usual magnetic, seismographic and meteorological observations were undertaken and various instruments adjusted, cleaned and repaired.

29. Computing Section.—The rough graphical adjustment of minor triangulation in 1/M sheet 35 has been carried out, and that of 1/M sheets 29 and 30 is in progress. Adjustment corrections have been applied to the data of the Assam Valley triangulation in sheet 78 N, and adjustment of sheet 45 G has been completed.

Four base-line figures have been ground,

Sir Aurel Stein's barometric heights in Persia have been reduced, and Captain Kingdon Ward's astronomical observations for time and latitude in his explorations in 1933 in south-east Tibet have been checked and completed.

The following publications have been printed at Dehra Dūn :—

(*a*) Geodetic Report 1933.
(*b*) Record Volume XXIV.
(*c*) Record Volume XXV.

One Indian and 2 Persian triangulation pamphlets and one levelling pamphlet have been printed.

Four Indian triangulation pamphlets and one levelling pamphlet have been reprinted. Addenda to 2 Indian triangulation pamphlets and 2 levelling pamphlets have been printed, and two secondary levelling pamphlets have been reproduced by gestetner.

30. Tidal Section.—Tide-tables of the Indian Ocean for 1935 for 69 ports were prepared and published in October 1933, and advance predictions for 14 ports were despatched in November 1933 to the Admiralty and to the Hydrographic departments of the United States and Japan.

The Madras tide-gauge was closed down by the port authorities on 31st August 1933 as a measure of economy. As however predictions for the port have been satisfactory in the past, the loss is not serious.

Automatic registrations were continued at Aden, Karāchi, Bombay, Colombo, Trincomali, Madras (up to 31st August 1933), Dublat (from 1st April 1933), Kidderpore and Rangoon. Observations of high and low water on tide-poles during daylight only were continued at Bhāvnagar, Chittagong and Akyab; similar observations were also taken at Chāndbāli from 1st April 1933 to 31st March 1934. The tidal observatories at Aden (May 1933) and Karāchi (February 1934) were inspected by the port authorities.

31. Latitude and Longitude.—(No. 14 Party). —Observations for latitude and longitude were made at 35 stations spaced along a line from the Lushai Hills through Calcutta to the neighbourhood of Rānchi. These observations provide an accurate section of the geoid in continuation of that observed in Burma in 1932-33.

Observations for latitude and local time were made with the prismatic astrolabe, the observer's personal equation being obtained by comparative observations with a portable transit (with impersonal micrometer eye-piece) at every fourth station. Greenwich time was obtained from the Rugby or Bordeaux signals. Geodetic position was generally obtained by observing at points previously fixed by triangulation. The observer was Mr. R. B. Mathur, B.A.

Observations for latitude only were at 36 stations spaced along a north and south line from Cape Comorin to near Hyderābād, Deccan. These observations provide an accurate section of the geoid along the southern part of the Great Arc. The observations were made by zenith telescope at points previously fixed by triangulation. The observer was Computer J. B. Mathur.

Observations for latitude and longitude with the small prismatic astrolabe were made at two stations in Madras and five stations in Ceylon by Major E. A. Glennie, D.S.O., R.E.

32. Gravity Observations.—(No. 14 Party).—Observations to determine the force of gravity were made at 41 stations in south-west India mostly lying between Nāsik, Madras and the West Coast, and also at 21 stations in Ceylon, and 9 in the Maldive Islands. In India and Ceylon transport was by two permanently engaged lorries, while the Maldive Islands were visited in the ship of the John Murray Expedition. The observer was Major E. A. Glennie, D.S.O., R.E.

33. Triangulation and Base-measurement.—(No. 15 Party).—During 1933-34 base-lines were measured at Padag Road near Dālbandin in Baluchistān, at Poona, and at Namtiali in the Sibsāgar district of Assam. They were measured with two pairs of invar wires, one pair in each direction.

The Padag and Poona bases were connected to existing primary triangulation, and the Namtiali base was connected to four hill stations of a projected series.

Eight new stations were built and 26 old secondary stations were visited and cleared, in preparation for a primary series which it is proposed to observe next year from near Shillong to the Nāga Hills south of Sibsāgar.

34. Levelling.—(No. 15 Party) *High Precision.*—During 1933-34, high precision levelling was carried out in Burma from Keng Tung to the Me Sai bridge on the Siamese border, 115 miles in both directions.

Precise Levelling.—In Burma, precise levelling was carried out from Mandalay to Lashio (225 miles).

PART 3.—TOPOGRAPHICAL WORK.

IV.—ABSTRACT OF TOPOGRAPHICAL WORK.

35. The following tables show the progress achieved to date in the topographical survey programme assigned to the Department in 1905.

Tables A & B. The figures in Tables A and B published prior to 1930-31 were found to be incorrect owing to unsystematic treatment in the past, alterations in circle boundaries and accidental omissions of surveys by one circle in an adjoining circle's area.

In order to make information readily available to the public regarding areas of modern surveys completed and published, the two tables have been recast and the areas are now given *by scales and not by circles*, the latter being of purely departmental interest.

It has not been found possible to calculate the figures for each scale for each quinquennium between 1905 and 1930, and consolidated figures are therefore given. The figures which were entered in the report for 1930-31 have been found inaccurate on re-examination, and revised figures have been entered in Table A.

Table C supersedes Tables C I and C II of the 1933 General Report and has been introduced to facilitate a more accurate assessment of cost rates for all varieties of survey.

A reference to these and to the map publication cost rates, ascertainable from the Director, Map Publication, should allow of a complete estimate for producing any map.

36. Progress. It was hoped in 1905 that modern maps on the 1-inch scale would be available for the entire Indian Empire within 25 years, but the work has been greatly delayed from various causes, and in 1913 the Secretary of State sanctioned a scheme for the reduction of the scale of survey in the less populous areas.

Allowing for these reductions of scale to scales of $\frac{1}{2}$-inch and $\frac{1}{4}$-inch to 1 mile, about half the work may be regarded as having been completed by 1925.

There is however a tendency to revert to the 1-inch scale in special cases, owing to the pressing requirements of geologists and engineers, and in accordance with the modern military view that this is the smallest scale suitable for tactical operations. Moreover some areas already surveyed on smaller scales have had to be resurveyed on a larger scale, as the smaller scales have been found inadequate.

Revision of modern surveys has also become necessary in certain frontier tracts and is badly needed in some other areas. The area revised during 1933-34 is given in Table B.

The present position of the mapping of India is shown in the first two *Index maps* at the end of this volume.

Table A.—Progress of Topographical Surveys since 1905.

Survey years.	1-inch and larger scales.	¾ and ½-inch scales.	⅜ and ¼-inch scales.	TOTALS.
	Sq. miles.	*Sq. miles.*	*Sq. miles.*	*Sq. miles.*
1905-30 ...	861,723	156,125	17,986	1,035,834
1930-33 ...	88,716	31,253	7,943	127,912
1933-34 ...	24,829	13,766	.....	38,595
Totals to 1934 ...	**975,268**	**201,144**	**25,929**	**1,202,341**
Balance remaining	*approximately 320,000*	*approximately 250,000*	*approximately 110,000*	*682,346*
Total programme				**1,884,687**

Table B.—*Revision and Resurvey of above work during the year.*

1933-34 ...	3,621	Nil	Nil	3,621

TABLE C.—Areas, out-turns and cost rates of Surveys, Computation and Mapping.

Party.	Class of work.		Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
						Field work.	Mapping or computations.	Total.	
				Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**FRONTIER CIRCLE.**
'A' Company.—									
Flat cultivated plains and sandy desert.	½-inch	**Traverse** ...	44 F & G ...	34 L. miles.	54 L. miles.	(a) 17·6 per L. mile.	.....	17·6	(a) Includes cost of computations.
Slightly elevated ground with cultivated plains and suburbs.	16-inch	**Traverse** ...	38 O ...	16 L. miles.	19 L. miles.	(a) 31·9 per L. mile.	.....	31·9	
Flat cultivated plains and sandy desert.	1-inch	Original survey...	39 O & 44 F	4,638	53	7·9	6·0	13·9	
High and medium hills with open cultivated valleys.	1-inch 1½-inch	Resurvey ... Resurvey ...	52 D ... 52 D ...	69 196	(b)	84·2	6·0	90·2	(b) Being training area, no out-turn has been shown.
Flat cultivated plains and sandy desert.	1-inch	Supplementary survey.	39 N ...	771	66	6·3	6·0	12·3	
	1-inch 1½-inch	Revision survey Revision survey	44 J ... 44 J ...	1,024 256	46	8·0	6·0	14·0	
Cultivated plains, and low foot hills rising to medium hills of 4,000.	1-inch	Correction survey	38 L & P ...	18 sheets	.....	227·3 per sheet.	0·3 per sheet.	227·6 per sheet.	

TABLE C.—Areas, out-turns and cost rates of Surveys, Computation and Mapping.

Party	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**FRONTIER CIRCLE.—** *Contd.*
'E' Company.—								
80% steep broken hills cut up by large rivers flowing in deep rocky valleys, 20% broad stony plains. Very sparsely populated.	**¾-inch** Original survey	35 I & M ...	1,412	38	17·3	5·3	22·6	
Steep broken hills along Afghān frontier, and rolling, low, rocky plains. Very sparsely populated. Severe weather conditions. Area under snow for some weeks.	**1-inch** Revision survey	34 J & K ...	462	101	12·5	(c)	(c)	1 surveyor under training for 3½ months.
	1½-inch Revision survey	34 J & K ...	257	110				(c) Mapping of this field work was not done during this year.
	2-inch Revision survey	34 J & K ...	387	93				
Flat town and suburban area, densely populated.	**3-inch** Revision survey	35 L & P ...	44	80				
Fair Mapping ...	**1½-inch** Original survey	.....	1,567	.....	.....	3·8	.....	
	1½-inch Revision survey	.....	2,711	.....	.....	6·2	.....	
	¾-inch Original survey	.....	1,054	.....	.....	5·3	.....	

TABLE C.—Areas, out-turns and cost rates of Surveys, Computation and Mapping.

Party.	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
			Sq. m.	Sq. m.	Rs. (Air survey compilation).	Rs.	Rs.	**FRONTIER CIRCLE.—** *Contd.*
No. 18 (Air Survey) Party.—								
Tīrāh, steep mountains, partly wooded (3,000 to 11,000 ft.).	1½-inch Original air survey.	38 K ...	255	.....	33·8	.....	.....	
Mohmand and Bājaur, medium hills with open cultivated valleys.	1½-inch Original air survey.	38 N ...	167	.....	56·6	.....	.....	
Black Mountain, open mountains (4,000 to 10,000 ft.).	1½-inch Original air survey.	43 B ...	102	10 (*d*)	20·7	.....	.....	(*d*) by surveyors under training.
Tripura State, Noākhāli district and Chittagong Hill tracts—Low undulating jungle-clad hills.	1½-inch Original air survey of detail.	79 M & N ...	1,412	43	4·6	.....	.....	
Peshāwar and Tribal Territory, open plains and low broken hills.	3-inch Revision air survey.	38 N ...	24	.....	39·2	.....	.....	

TABLE C.—Areas, out-turns and cost rates of Surveys, Computation and Mapping.

Party.	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**FRONTIER CIRCLE.—** *Contd.*
No. 18 (Air Survey) Party.—*Concld.*								
Nanga Parbat high & snow-clad mountains.	1/100,000 Original oblique air survey.	43 ...	87	.....	113·9 (e)	.....	.....	(e) Experimental survey by class I officer.
Fair mapping	1½-inch Original survey ...	38 K & O ...	746	.....	.....	18·8	.....	
No. 23 Party.—								
Flat cultivated plains, interspersed with scrub, long grass and trees.	..... Tertiary levelling	44 O, 53 C, D, G & H.	1,791	17·5	27·39 (f) per sq. mile.	7·47 (g) per sq. mile.	**34·86 per sq. mile.**	(f) Includes field computation. (g) Includes preparation of 4-inch spot height charts.
Flat cultivated plains, interspersed with scrub, long grass and trees. (Survey by resection from auxiliary points fixed from 25-acre rectangulation control.)	4-inch Resurvey ...	44 O, 53 C, D, G & H.	1,859	12·1	33·68 (h) per sq. mile.	16·73 (i) per sq. mile.	**49·81 per sq. mile.**	(h) Includes reduction of musavis. (i) Includes construction and fair-drawing of 4″ contour sheets.

Table C.—Areas, out-turns and cost rates of Surveys, Computation and Mapping.

Party.	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computation.	Total.	
			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**FRONTIER CIRCLE.—** *Concld.*
No. 6 Drawing Office.								
Map examination ...	**1-inch** Sheets ...	.....	.....	.....	.....	·75	.....	
Map examination ...	**½-inch** Sheets ...	.....	.....	.....	.....	·06	.....	
Map examination ...	**3·8-inch** Guide Map ...	.....	.....	.....	.....	4·19	.....	
Map examination ...	**1/25,000** Guide Map ...	.....	.....	.....	.....	5·19	.....	
Map examination ...	**3-inch** Guide Map ...	.....	.....	.....	.....	13·0	.....	
Colour Patterns ...	**1-inch** Sheets ...	.....	.....	.....	.....	·75(*j*) ·63(*k*)	.....	(*j*) A Coy. & No. 18 Party. (*k*) E Coy.
Colour Patterns ...	**1/20,000** Guide Map ...	.....	.....	.....	.....	·19	.....	

TABLE C.—Areas, out-turns and cost rates of Surveys, Computations and Mapping.

Party.	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**GEODETIC BRANCH.**
No. 1 Party.—								
20% High, lightly wooded Arāvalli Range; 30% sandy, undulating country; 50% flat country interspersed with hills.	½-inch **Triangulation**	45 C, D, H & L	10,019	650	1·7	·6	2·3	No. 2 D. O. costs for examination and preparation of colour patterns of this unit:—Rs. 1,931-0-0.
50% High, lightly wooded Arāvalli Range; 50% open undulating country.	1-inch **Triangulation**	45 H ...	769	499	1·8	·6	2·4	
5% Lightly wooded intricate hills; 30% sandy, undulating country; 65% open undulating country.	½-inch Original survey	45 G, K & M and 55 A.	7,488	76·6	5·6	3·2	8·8	
20% Intricate, lightly wooded Arāvalli Range; 65% flat area with isolated hills; 15% flat area with open jungle.	1-inch Original survey	45 G & K ...	1,677	26·1	10·2	6·1	16·3	

TABLE C.—Areas, out-turns and Cost rates of Surveys, Computations and Mapping.

Party.	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
			Acres.	Acres.	Rs.	Rs.	Rs.	**GEODETIC BRANCH.—** *Concld.*
No. 20 (Cantonments) Detachment.—								
Cantonments (Plains) 60% open and 40% congested.	16-inch **Traverse** ...	53 G, J, P & 79 B.	11,746	813·6	1·0	0·3	1·3	Dehra Dūn, Bareilly and Barrackpore Cantonments. Sahāranpur Remount Depôt and Ishapore Estate.
Cantonments (Hills) 70% heavily wooded and 30% fairly heavily wooded and interspersed with buildings.	16-inch **Traverse** ...	53 O ...	645	173·8	2·8	0·3	3·1	Naini Tal Cantonment. Excludes boundary traversing of Estate at Mussoorie of 5 acres.
Cantonments (Plains) average congestion.	64-inch **Traverse** ...	53 J, P & 79 B	131	112·8	4·2	2·8	7·0	Dehra Dūn, Bareilly and Barrackpore Cantonments.
	16-inch **Levelling** ...	53 G, J, P & 79 B.	11,746	3660·0	0·1	.....	0·1	Dehra Dūn, Bareilly and Barrackpore Cantonments. Sahāranpur Remount Depôt and Ishapore Estate.
Cantonments (Hill) ...	16-inch **Levelling** ...	53 O ...	645	1032·0	0·2	.....	0·2	Naini Tāl Cantonment.
Cantonments (Plains) 60% open and 40% congested.	**16-inch** Re-survey ...	53 G, H & O. 54 K, M & 63 G, J.	14,425	245·8	1·7	0·9*	2·6	Shāhjahānpur, Allahābād and Fyzābād Cantonments. *The areas mapped do not actually correspond with those surveyed but include mapping arrears in sheet 53 G, H, O, 54 K completed in period under report.
Cantonments (Plains) average congestion.	**64-inch** Re-survey ...	53 G, H & O. 54 M & 63 G, J.	25	9·6	19·2	10·6*	29·8	

TABLE C.—Areas, out-turns and cost rates of Surveys, Computations and Mapping.

Party.	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
No. 4 Party.—			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**EASTERN CIRCLE.**
Open cultivated plains, Test lines only.	1-inch **Traverse** ...	72 G ...	1,614	538 sq. m. 80 L. miles.	1·3	1·2	2·5	
50% heavily wooded hills up to 2,000 feet. 50% dense wooded plains (not much undergrowth) with scattered cultivation. Surveyed partly by resection from triangulation and partly by traverse methods.	1-inch Original Survey	73 C ...	46	21·0	18·0	7·5(a)	25·5	(a) The total cost of examination in No. 5 Drawing office was Rs. 479.
15% intricate scrub covered and very rocky hills, rising to 1,500 feet, surveyed by resection and planetable traverse. 70% cultivated plains with numerous trees and topes, and 15% open cultivated plains surveyed by resection from auxiliary points fixed from traverse control.	1-inch Supplementary Survey.	72 C & D & 73 C.	5,354	28·0	13·6	7·5(a)	21·1	

Table C.—Areas, out-turns and cost rates of Surveys, Computations and Mapping.

Party.	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
No. 5 Party.—			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**EASTERN CIRCLE.—** *Contd.*
90% dense forest with undergrowth and 10% cultivation area near villages (traverse methods only were possible).	1-inch **Traverse** ...	64 G & H ...	175* linear miles.	41* linear miles.	13·9	9·2	**23·1**	* It is not possible to give a true figure of the area in sq. m. as the traverse work was carried out to supplement points in the sheets already traversed and triangulated.
70% low hills covered with dense jungle, 30% cultivation near villages (Survey chiefly by planetable traverse with occasional resected fixings).	**1-inch** Original survey ...	64 D ...	4,166 (a)	39 (b)	14·6	5·6 (c)	**20·2**	(a) Includes 262 sq. miles surveyed by 3 men under training.
Open flat cultivated country (Survey by resection).	**1-inch** Original survey ...	64 G ...						(b) Excludes men under training.
50% low wooded hills requiring jungle clearing, 50% open cultivated country (survey by planetable traverse in jungle area, and by resection in the open country).	**1-inch** Original survey ...	64 H ...						(c) The total cost of examination in No. 5 Drawing Office was Rs. 233.

TABLE C.—Areas, out-turns and cost rates of Surveys, Computations and Mapping.

Party.	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
No. 12 Party.—			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**EASTERN CIRCLE.—** *Concld.*
Parallel ranges of heavily wooded hills up to 3,000 feet with wide valleys below 500 ft. Survey largely by traverse except on upper slopes where "jhums" allowed resection.	½-inch Original survey ...	84 A ...	487	23·1	28·4	(a)	28·4 a)	(a) Mapping not yet taken up.
50% as above and 50% extremely heavily wooded undulating country. Survey mainly by traverse.	1-inch Original survey ...	84 A ...	611(b)	7·7	56·7	15·2 (c)	71·9	(b) Includes 8 Square miles also surveyed on ½ inch scale.
50% undulating country and 50% low parallel ranges with wide valleys, the whole heavily wooded except for scattered "jhums" and cultivation. Survey of detail from air photos, checked and classified on ground. Contoured on ground mainly from resected heights.	1½-inch(c) Original survey ...	79 M & N ...	1,386	29·1	41·1(d)	21·5 (e)	62·6	(c) *Vide* also Report of No. 18 Party, Page 34. (d) The cost rate is made up as follows:— Air Photography 18·0 Air Survey (by No. 18 Party) ... 4·6 Actual cost on ground (excluding supervision and moves to and from ground) ... 6·7 Share of overhead (including supervision and moves to and from ground) ... 11·8 Total 41·1

(e) The total cost of examination in No. 5 Drawing Office was Rs. 348.

TABLE C—Areas, out-turns and cost rates of Surveys, Computations and Mapping.

Party.	Class of Work.		Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per sq. m. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
						Field work.	Mapping or computations.	Total.	
No. 6 (South India) Party.—				Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**INDEPENDENT PARTIES.**
80% Hills up to 4,000 feet, mostly heavily wooded and sparsely inhabited; 20% coastal plain with isolated hills up to 2,000 feet.	1-inch	**Triangulation**	65 I, M & 74 A	6,488	300·0	3·24	0·41	**3·65**	
30% Hills rising steeply up to 5,000 feet with some jungle often bamboo, but frequently cultivated (very little traverse required); 70% Coastal plain with isolated hills up to 1,500 feet high covered with low scrub. (Nearly all resection methods but little traverse required, near coast).	**1-inch**	Original survey ...	65 N, 74 B ...	4,884	24·5	16·95	6·64†	**23·59**	
½-inch compiled mapping ...	**½-inch**	Compiled Mapping	48, 65 ...	10 shts.	.....	.....	1·6†	**1·6**	
¼-inch „ „ ...	**¼-inch**	Ditto	48, 56, 58, 65	10 „	.....	.....	0·4†	**0·4**	†Includes cost of colour patterns.

TABLE C.—Areas, out-turns and Cost rates of Surveys, Computations and Mapping.

Party.	Class of work.	Sheet No.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
No. 10 (Burma) Party.			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**INDEPENDENT PARTIES.—Contd.**
Low hills, rising to 3,000 feet and cultivated tidal area, fairly dense jungle.	1-inch **Triangulation**	84 D & H ...	1,947	627	2·99	2·48	5·47	
High hills, rising to 10,000 feet, fairly dense jungle.	½-inch **Triangulation**	84 F, G & H ...	8,301	1,274	3·05	1·11	4·16	
High hills, rising to 8,000 feet, fairly dense jungle (Re-section).	**½-inch**	Original survey ... 84 E & F ...	4,379	113·5	10·33	4·22	14·55	
Low hills, dense jungle (traversing and occasional re-section).	**1-inch**	Original survey ... 84 I ...	1,000	15·5	47·59	12·37	59·96	
High hills, rising to 4,000 feet, fairly dense jungle (Re-section and occasional traverse).	**1-inch**	Original survey ... 84 J ...	550	39·9	20·81	12·37	33·18	

TABLE C.—Areas, out-turns and Cost rates of Surveys, Computations and Mapping.

Party.	Class of work.		Sheet No.	Area in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
						Field work.	Mapping or computations.	Total.	
				Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**INDEPENDENT PARTIES.—Concld.**
No. 10 (Burma) Party.—*Concld.*									
Low Hills, fairly dense jungle (re-section).	1-inch	Re-survey ...	84 I ...	94	94·0	18·35	12·37	30·72	
	1-inch	Compiled mapping	96 J, 85 N ...	167	.....	.....	20·32	20·32	
	½-inch	Compiled mapping	83 L, 84 I, & J. 92 J, 94 C.	6,554	.....	.....	2·90	2·90	
	¼-inch	Compiled mapping	83 N, 85 P, 85 I	7,752	.....	.....	0·82	0·82	
		Preparation of Colour Patterns.	.....	22 Sheets	.....	.....	per sheet. 161·36	161·36	
		Office Copy corrections and miscellaneous work.	.....	.....	.....	.....	.....	.....	Total Cost of Office Copy corrections & miscellaneous work Rs. 8,691.

V.—SURVEY REPORTS, FRONTIER CIRCLE.

DIRECTORS:—{Colonel S. W. Sackville Hamilton, D.S.O., to 29-11-33 and again from 17-2-34.
{Colonel C. G. Lewis, O.B.E., from 30-11-33 to 16-2-34.

37. Summary.—The units administered by the Frontier Circle were 'A' and 'E' Companies, Nos. 18 and 23 Parties, and No. 6 Drawing Office.

38. Training.—One Class I Officer on probation and six soldier surveyors were under training in 'A' Company during the field season.

39. Special.—During the year the Staff College Junior students visited the Office of 'E' Survey Company for brief lectures and demonstration of map making and reproduction.

40. Areas Surveyed.—

50 linear miles of traversing;
1,791 sq. miles of tertiary levelling;
1,412 sq. miles of ¾-inch original survey;
4,638 sq. miles of 1-inch original survey;
69 sq. miles of 1-inch resurvey;
196 sq. miles of 1½-inch resurvey;
1,859 sq. miles of 4-inch resurvey;
771 sq. miles of 1-inch supplementary survey;
1,486 sq. miles of 1-inch revision survey;
513 sq. miles of 1½-inch revision survey;
387 sq. mlies of 2-inch revision survey;
44 sq. miles of 3-inch revision survey;
1-inch correction surveys of 18 sheets.

By No. 18 (Air Survey) Party.—

2,730 sq. miles photographed;
585 sq. miles compiled;
1,412 sq. miles compiled for detail only.

'A' Survey Company.

Officer Commanding.—{Lt.-Colonel O. Slater, M.C., R.E., to 31-7-34.
{Mr. W. H. Strong, M.B.E., from 1-8-34.

41. General.—The party continued surveys in the Ferozepore, Kāngra, Lahore, Montgomery, Multān and Muzaffargarh districts, and in Bahāwalpur and Faridkot States of the Punjab and in Bikaner State of Rājputāna.

In addition, correction surveys were carried out in Attock, Miānwāli and Shāhpur districts of the Punjab and Bannu, Dera Ismail Khān, and Kohāt districts of the N. W. F. P. Traverse operations were undertaken in Bikaner State to conneet the state rectangulation with departmental triangulation stations.

The field headquarters opened at Ferozepore Cantonment on 16th October 1933 and closed on 15th April 1934.

42. Personnel.—The average strength of the Company during the year was 2 Class I, 3 Class II and 3 U. S. Officers, 27 Surveyors, 1 Draftsman, 5 Computers, 3 Clerks and 8 Soldier Surveyors.

Lieut. J. S. O. Jelly, R.E. was transferred to 'E' Company in May 1934.

Mr. I. K. Ponnappa joined 'A' Company from No. 18 Party in April 1934 and Mr. Muhammad Akbar joined from No. 6 Drawing Office in March 1934.

43. Areas Surveyed.—

50 linear miles of traversing;
4,638 sq. miles of 1-inch original survey;
69 sq. miles of 1-inch resurvey;
196 sq. miles of 1½-inch resurvey;
771 sq. miles of 1-inch supplementary survey;
1,024 sq. miles of 1-inch revision survey;
256 sq. miles of 1½-inch revision survey;
1-inch correction surveys of 18 sheets.

44. Field work, which was completed in April, was organised as follows:—

Camp (1) under Mr. W. H. Strong, M.B.E. with Mr. E. R. Wilson and 12 Lower Subordinates completed 1,524 square miles of 1-inch original survey and 1,280 square miles of 1-inch and 1½-inch revision surveys in sheets 44 F & J. In addition Mr. Strong supervised a small drawing section of 4 Lower Subordinates who were employed on arrears of mapping from last recess.

Camp (2) under Rai Sahib Chuni Lal Kapur with Mr. Bashirullah Khan (U. S. S.) and 11 Lower Subordinates, completed 3,114 sq. miles of 1-inch original survey and 771 sq. miles of 1-inch supplementary survey in sheets 39 N and O. In addition Rai Sahib Chuni Lal Kapur supervised the 2 Lower Subordinates employed on correction surveys in sheets 38 L & P.

The area of *Camps (1)* and *(2)* lay for the most part in the irrigated and cultivated area on either side of the Sutlej and Chenāb rivers. Survey was based on rectangulated corner stones laid out by the department in recent years. Some distance south of the Sutlej and also in the Thal between the Chenāb and the Indus the cultivation gives way to the original *pat* desert with shifting sand dunes. No contouring was attempted in the area but heights will be typed on the final maps with the aid of the irrigation level charts.

Camp (3) under Mr. Sardar Khan (U. S. S) was organised for training in the Kāngra Valley. Lieut. J. S. O. Jelly, R.E., one Lower Subordinate and six soldier surveyors completed 265 sq. miles of resurvey on the 1-inch and 1½-inch scale in sheet 52 D. The area was ideal for training purposes, as it contained mountains up to 16,000 feet, but for the most part it consisted of scrub jungle hills and cultivated valleys with bold under features.

Traversing.—A total of 34 linear miles was traversed to connect the Bīkaner State rectangulated area with G. T. Stations in its vicinity so that the corner stones of this area may be utilised as a basis for next season's survey.

The boundary of Kohāt cantonment 16 linear miles long, was also traversed on payment. This boundary was not completely demarcated at the time of the survey of the cantonment in 1923-24.

45. Recess Duties.—With arrears from last recess including 2 sheets of the Lahore Guide Map the Company has a total of 37 sheets for mapping. Of these, 26 sheets were completed in recess by four drawing sections, and the remaining 11 sheets will be mapped during the coming field season.

Computations. Mr. Saiyid Irshad Ahmad with 4 Lower Subordinates, one of whom was also employed from time to time on traversing, completed during the year the graphical adjustment of all triangulation which is to be published in the form of grid pamphlets. In addition, the computations of the triangulation done last year in the Bahāwalpur desert and all the traverse work done during the year under report were completed.

'E' Survey Company.

Officer Commanding.—{Captain J. B. P. Angwin, R.E., to 23-10-33.
Major T. M. M. Penney, R.E., from 24-10-33.

46. General.—The field and recess headquarters were at Quetta.

The field work consisted of revision surveys in areas west of Quetta and in Karāchi, and original surveys two hundred miles to the south of Quetta in Kalāt State astride the Quetta-Kalāt-Karāchi road.

Work in recess consisted of a heavy mapping programme.

Due to the field work of the previous year having been confined to revision surveys, a greater area had been revised than could be mapped during the recess season, and there were considerable arrears of mapping to be completed.

It was found more satisfactory and quicker to re-draw completely in most cases.

Useful assistance in the reduction of arrears of fair mapping was given by the Director, Eastern Circle.

47. Personnel.—The average strength during the year was 2 Class I, 1 Class II, 3 Upper Subordinate officers, and 14 Lower Subordinates (excluding 2 clerks, 2 computers, and 15 reproduction section personnel).

Lieut. R. C. N. Jenney proceeded on leave in March and was replaced by Lieut. J. S. O. Jelly in May.

48. Areas Surveyed.—

1,412 sq. miles of ¾-inch original survey.
462 sq. miles of 1-inch revision survey.
257 sq. miles of 1½-inch revision survey.
387 sq. miles of 2-inch revision survey.
44 sq. miles of 3-inch revision survey.

49. Field Work.—The field work was carried out between the end of October and the middle of April.

Camp (1) consisted of Lieut. R. C. N. Jenney with Mr. V. D. Chopra (U. S. S.) and three surveyors. This camp carried out the revision work in Karāchi and in sheets 34 J & K. Mr. V. D. Chopra acted as Assistant Camp Officer and also himself did 129 square miles of revision survey on the 1½-inch scale.

Camp (2) under Mr. H. M. Critchell, with Mr. Khushal Khan (U. S. S.) as assistant Camp officer and seven surveyors, carried out the original survey in Kalāt State in sheets 35 I & M.

Nature of country surveyed. The country surveyed was typical Baluchistān country, bare rocky plains and steep hills. January was particularly cold and the surveyors doing the revision survey worked particularly well in the very severe climatic conditions; in parts of *Camp (2)* area in Kalāt State snow was experienced for the first time for 20 years.

50. Office Work.—Three draftsmen under Mr. Chiragh Shah were employed on fair mapping and miscellaneous drawing work throughout the field season.

During recess,

Section (1) under Lieut. J. S. O. Jelly assisted by Mr. Chiragh Shah, had 6 draftsmen and completed 4 fair sheets of arrears mapping.

Section (2) under Mr. H. M. Critchell, assisted by Messrs. V. D. Chopra and Khushal Khan and 8 draftsmen completed 12 fair sheets of arrears mapping, which includes some sheets completed during the field season.

Lieut. J. S. O. Jelly also generally supervised the reproduction section and Mr. H. M. Critchell was in charge of the office copies.

51. Reproduction Section.—This section, under Litho-draftsman Shahabuddin, was employed on miscellaneous work consisting largely of spot level charts for the Irrigation Department of the Punjab. Lithographic mosaicing was also successfully carried out by this section for the first time. One or two rush jobs were satisfactorily done as a form of war training.

52. Military Training.—No combined training with other arms was carried out.

As the company as a whole will not be taking the field until most of the arrears of mapping have been completed, and as it was essential to clear off some of the older sheets before the mapping was interrupted, individual training of those who would be employed in war was commenced towards the end of the recess season with the intention of continuing it throughout the winter.

No. 18 (Air Survey) Party.

Officer in Charge.—Captain D. R. Crone, R.E.

53. General.—Field headquarters were transferred from Peshāwar to Risālpur, where the office opened on 28th October 1933.

The office moved to Murree as usual for recess on 10th April 1934.

The officers of No. 39 (Bomber) Squadron visited the office at Risālpur on Saturdays throughout February 1934 and had the methods of air survey and reproduction demonstrated to them.

The Northern Command Annual Intelligence Course also had the work of the party demonstrated to them in Murree, as usual.

54. Personnel.—The average strength of the party was 1 Class I, 1 Class II and 3 U. S. Officers and 15 Lower Subordinates (excluding clerks and reproduction section personnel).

Lieut. J. S. O. Jelly, R.E., was transferred to 'A' Company on 11th October and Mr. J. C. Berry to No. 12 Party on 6th February.

55. Areas Surveyed.—

2,100 sq. miles photographed vertically;
630 sq. miles photographed obliquely;
524 sq. miles compiled (original survey);
1,412 sq. miles compiled for original detail only;
24 sq. miles compiled (revision survey);
37 sq. miles compiled (oblique revision survey).

56. Field Work.—No 1 Wing Station, Royal Air Force, Kohāt, supplied vertical photographs of 345 square miles of tribal territory in sheet 38 H and L for original air survey. Experimental work with the 20-inch lens and infra-red filter was also carried out.

No. 2 Wing Station, Royal Air Force, Risālpur, supplied vertical photographs of 185 square miles in the tribal territory in sheets 38 M and N and 43 A & B and obliques of 220 square miles in 43 A for original mapping. They also supplied oblique photographs of 80 square miles in 43B for experimental work on height determination.

Mr. Muzaffar Husain inspected triangulation stations in the Khyber in March 1934.

Gilgit Flight.—The annual flight to Gilgit carried out by a composite flight from Risālpur obtained oblique overlaps for survey purposes of the north face of Nanga Parbat (43 I) and of the north face of Rakaposhi (42 L). An Anaglyph from the former strip is illustrated on Plate IB.

Tripura Air Survey.—The Indian Air Survey and Transport Co., Dum-Dum, photographed 1,510 square miles in Tripura State, Noākhāli District, and Chittagong Hill Tracts in Sheets 79 M and N on the 3-inch scale.

Experiments.—The plotting carried out from air photographs by the Wild Company on their Autograph was tested in the field by Captain D. R. Crone, R.E., who made a base extension in the terminal overlaps and by Mr. I. K. Ponnappa (U. S. S.) who carried a traverse through the Kohāt Pass.

The tests indicate that the Wild method of machine plotting is capable of providing *control* for graphical air survey methods in areas not more than 20 miles from accessible ground, when the scale of publication of the final maps is the 1-inch scale.

57. Compilation.—*Tripura Air Survey.* The first photographs taken by the Indian Air Survey and Transport Co. were received at Risālpur on 12th December, 1933. Two Class II Officers, 11 surveyors and one part time U. S. Officer were engaged on the detail survey of the 1,412 square miles which was completed and despatched to No. 12 Party with the necessary material on the 1½-inch scale for work in the field, on 14th February.

Mr. J. C. Berry and 4 surveyors were transferred to No. 12 Party on 6th February to undertake part of the field work of this survey (see para. 95).

Black Mountain Survey (43 B/14).—Experimental methods of height fixing from oblique photographs were employed in this area and

NOTICES

I. Work done by the Survey of India.

II. How to obtain maps and other publications.

III. List of Agents for the sale of maps.

I. WORK DONE BY THE SURVEY OF INDIA

APPLICATION FOR SURVEYS OF ANY KIND, whether for private or Government purposes, should be made to the following officers:

The Director,	Frontier Circle,*	Survey of India,	Simla. (*Tel.* "*Surfrontier*").
,,	,,	Geodetic Branch,*	,,	,,	Dehra Dūn. (*Tel.* "*Surtrig*").
,,	,,	Eastern Circle,*	,,	,,	Shillong. (*Tel.* "*Sureast*").
,,	O. C.	No. 6 (South India) Party,*	,,	,,	Bangalore. (*Tel.* "*Surfield Six*").
,,	,,	No. 10 (Burma) Party,*	,,	,,	Maymyo. (*Tel.* "*Surfield Ten*").

FOREST AND CANTONMENT SURVEYS, LEVELLING, TRIANGULATION AND TIDE TABLES. Advice in regard to these, and on scientific questions, is obtainable from the *Director, Geodetic Branch, Survey of India, Dehra Dūn*, who undertakes a good deal of levelling and similar work for municipalities and engineering projects, on payment. (*Telegrams* "*Surtrig*").

MAPS AND ILLUSTRATIONS can be printed by the *Director, Map Publication*, Survey of India, 13 Wood Street, Calcutta, for Government Departments only, and special maps can also sometimes be prepared, on payment.

THE MATHEMATICAL INSTRUMENT OFFICE, Survey of India, 15 Wood Street, Calcutta, is a well equipped Government Factory which supplies, manufactures and repairs all kinds of Surveying, Drawing, Optical, Meteorological and Medical instruments. It also manufactures special instruments for experimental purposes and receives back surplus instruments on valuation, from all Government Departments, whether Imperial or Provincial.

The Price List, Rules and Regulations and Forms for Indents, Repairs and Deposits are supplied gratis on application. (*Telegrams* "*Surinst*").

GENERAL ENQUIRIES should be addressed to the Assistant Surveyor General, 13 Wood Street, Calcutta. (*Telegrams* "*Surveys*"), as the Surveyor General of India is on tour during most of the year.

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* *Provinces and States in each Survey Circle.*

1. *FRONTIER Circle*
Kashmir and Jammu
N. W. F. Province
Baluchistān
Punjab and Delhi
Punjab States
Bīkaner and States of W. Rājputāna.
Part of Bombay†
Cutch.

2. *GEODETIC Branch*
United Provinces
Central India
Gwalior
Ajmer-Merwāra
E. Rājputāna States
Baroda
Part of Bombay†
States of Western India (less Cutch).

3. *No. 6 (South India) Party.*
Madras Presidency
Madras States
Hyderābād
Mysore and Coorg
Part of Bombay†

4. *EASTERN Circle*
Central Provinces (including Berār).
Bihār and Orissa
Bengal Presidency
Assam and Sikkim.
States of Eastern India.

5. *No. 10 (Burma) Party.*
Burma.

† *Bombay Presidency*—Sind is in the Frontier Circle: Northern Div. in Geodetic Branch, remainder in No. 6 (South India) Party.

II. HOW TO OBTAIN MAPS AND OTHER PUBLICATIONS

SURVEY OF INDIA MAPS are obtainable from the Map Office, 13 Wood Street, Calcutta (*Tel.* "*Surmaps*"). Also to some extent from the Agents detailed overleaf and from the Directors of Survey Circles. A MAP CATALOGUE, which itself forms a useful atlas of India and surrounding countries, can be obtained for *Re. 1/-* (*post free*).

FOREST AND CANTONMENT MAPS are obtainable from the Map Office, Survey of India, Dehra Dūn. (*Tel.* "*Surtrig*").

GEOLOGICAL MAPS are prepared by and can be obtained from the Director, Geological Survey, Calcutta.

SURVEY PUBLICATIONS OTHER THAN MAPS are obtainable through the Director, Geodetic Branch, Survey of India, Dehra Dūn, who will supply *gratis* a full *Catalogue* of the following:

(*a*) *Trigonometrical data.* Triangulation pamphlets, each covering one square degree, giving descriptions, positions, and heights of triangulated points and other data, with chart. Levelling pamphlets, each covering $4° \times 4°$, giving descriptions and heights of Bench-marks, with chart.

(*b*) *Tidal Predictions*, published annually in advance as *Tide Tables of the Indian Ocean.* These tables contain predictions for about 40 Indian and Burmese ports, and for about 25 other ports in various parts of the world.

(*c*) *Geodetic works of Reference*—The G.T.S. series of twenty-one large quarto volumes describing in detail the geodetic operations of the Great Trigonometrical Survey from 1800. Detailed accounts are given of the Base-line measurements, of the reduction of the Geodetic Triangulation treated in five portions, of the early Pendulum observations, of Telegraphic Longitude and Astronomical Latitude operations, of Tidal observations, and of Levelling of high precision.

(*d*) *Historical, and General Reports*, including the "Memoirs on Indian Surveys" by Sir Clements Markham and C.E.D. Black: also Annual Reports, Narrative Reports, Record Volumes, and the annual Geodetic Reports.

(*e*) *Miscellaneous.* Papers on Geodesy, Exploration, etc. including a "Sketch of the Geography and Geology of the Himalaya Mountains and Tibet" (in 4 parts) revised in 1933.

(The Catalogue is also included in the Annual Geodetic Report.)

III. LIST OF AGENTS FOR THE SALE OF MAPS

OUT OF INDIA.

England.	1.	Secy. to the High Commissioner for India. (Genl. Deptt.), India House, Aldwych, London, W. C. 2.
	2.	Sifton Praed & Co. Ltd., The Map House, 67 St. James's Street, London, S. W. 1.
America.	3.	C. S. Hammond & Co., 30 Church St., Hudson Terminal, New York, and 75 State St., Boston, Mass.
Germany.	4.	Dietrich Reimer, Berlin, S. W. 48.
China.	5.	The French Book Stores, Grand Hotel de Pekin, Peiping.

INDIA.

Āgra.	1.	English Book Depot, Tāj Road.
	2.	Indian Army, Book Depot, Dayal Bagh.
Allahābād.	3.	North India Christian Tract and Book Society.
Ambāla.	4.	Ram Chander & Sons.
Bareilly.	5.	London Book Depot.
Bombay.	6.	Thacker & Co.
	7.	D. B. Taraporevala Sons & Co.
	8.	King & Co., 213-215 Badri Mahal, Hornby Road.
Calcutta.	9.	W. Newman & Co., 3 Old Court House Street.
	10.	Automobile Association of Bengal, 40 Chowringhee.
	11.	City Map Agency, Govt. Book Depot, 8 Hastings St.
	12.	Oxford Book & Stationery Co., 37/39 Park St.
	13.	Thacker Spink & Co., 3 Esplanade East.
Cawnpore.	14.	Advani Brothers.
Dacca.	15.	Provincial Library.
Darjeeling.	16.	Oxford Book & Stationery Co.
Delhi.	17.	Oxford Book & Stationery Co., Kashmere Gate.
	18.	Ramesh Book Depot and Stationery Mart.
	19.	J. M. Jaina & Brothers, Mori Gate.
	20.	Bhawani & Sons, Connaught Place.
Ferozepore.	21.	English Book Depot, Wazir Ali Buildings.
Indore.	22.	The Manager, Dak Bungalow, Indore.
Jhānsi.	23.	English Book Depot.
Karāchi.	24.	Aero Stores, Napier Road.
	25.	Keale & Co., Book Corner, Elphinstone Street.
Kasauli.	26.	Ram Chander & Sons.
Kashmīr.	27.	Cockburns Agency, Srīnagar.
	28.	Beckett & Co., Srīnagar.
	29.	D. G. Smith & Co., Srīnagar.
Lahore.	30.	Punjab Religious Book Society, Anarkali.
	31.	Standard Book Depot.
	32.	Oxford Book & Stationery Co.
Lucknow.	33.	Davy & Co.
Madras.	34.	Higginbothams Ltd.
Meerut.	35.	Oxford Book & Stationery Co.
Murree.	36.	J. Ray & Sons, The Mall.
Mussoorie.	37.	The Mussoorie Book Society.
	38.	Davy & Co.
Muzaffarpur.	39.	Burman & Co.
Nagpur.	40.	Superintendent, Govt. Printing, Book Depot.
Peshāwar.	41.	Faqir Chand Marwah, Peshāwar Cantonment.
	42.	J. Ray & Sons, Arbab Road.
	43.	Sham Lal & Sons.
Quetta.	44.	Standard Book Stall, Club Corner.
Rangoon.	45.	The Curator, Government Book Depot, Burma.
Rāwalpindi.	46.	J. Ray & Sons, 43 K & L, Edwardes Road.
Simla.	47.	Oxford Book & Stationery Co.

ANAGLYPH OF PLATE I A.

THE READER SHOULD USE THE COLOURED SPECTACLES IN THE POCKET AT THE END OF THIS VOLUME AS WELL AS THE SPECTACLES WHICH HE USUALLY WEARS FOR READING. THE FOREGROUND SHOULD BE FOCUSSED FIRST.

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AIR PHOTOGRAPH OF THE APPROACH TO NANGA PARBAT (26,660 FT.), FROM THE NORTH.

SHOWING THE ROUTE AND CAMPS OF THE 1934 GERMAN NANGA PARBAT EXPEDITION. THE HIGHEST POINT REACHED ON THE MOUNTAIN WAS 26,000 FEET, BUT DURING THE DESCENT THREE CLIMBERS AND FOUR PORTERS PERISHED BETWEEN CAMPS 5 AND 7.

PLATE II.

AIR PHOTOGRAPH OF NANGA PARBAT (26,660 FT.) FROM THE NORTH WEST.

SHOWING THE APPROXIMATE POSITIONS OF THE HIGHEST CAMPS OF THE 1934 GERMAN NANGA PARBAT EXPEDITION.

R.A.F. Official: Crown Copyright Reserved.

the compilation was finally completed and sent to 'A' Company for fair mapping.

The remaining areas of the Party's programme were completed for detail only. They will now be completed for contouring by the method employed on the Black Mountain survey as fully trained personnel become available.

Fair mapping.—746 square miles compiled from Air Photos in previous years have been fair mapped during the year under report.

58. Methods of Survey.—The method of surveying from oblique photographs (described in Appendix I of the General Report for 1931-32) was extended to dispense with the visible horizon. The initial research work was carried out on the Nanga Parbat oblique strip and a map of 37 square miles on the 1:100,000 scale compiled of the north face and supplied as a climbing map to the late Herr Willy Merkl, leader of the ill fated German Nanga Parbat Expedition of 1934 (see Plates I and II).

The method was then applied to the Black Mountain survey as described above.

59. Photographic Equipment.—Messrs. Ross Ltd. kindly lent a 6-inch (Extra Marginal Illumination) lens for experimental work in the F/8 camera. A lens cone was adapted by the Mathematical Instrument Office and experimental photographs were taken with the lens by No. 2 Wing Station, Royal Air Force, Risālpur. These tests show that the lens will cover the 7 inch by 7 inch surface of the F-8 film satisfactorily at an aperture of F. 6·3 and that the illumination is remarkably even, in spite of the loss of light at the surfaces of the focal register glass.

60. Reproduction Section.—For detail of the work of the reproduction section see para. 131 page 67.

No. 23 (Irrigation Surveys) Party.

Officer in Charge.—Mr. C. H. Tresham, V.D.

61. General.—This party, which works for the Punjab Government, continued the survey of the area covered by the Bhakra Dam Irrigation Project. The recess and field headquarters were at Solon and Rohtak respectively, the latter opening on 21st October and closing on 16th April.

62. Personnel.—The field strength of the party was one Class I, 4 Class II and 4 U. S. Officers and 75 Lower Subordinates.

Mr. Ghulam Hasan (U. S. S.) was transferred to No. 6 D. O. from 11th October and was replaced by Mr. Abdul Rashid Khan (U. S. S.).

Mr. N. M. Bopaiah (U. S. S.) was transferred to No. 2 D. O. from 23rd February.

Messrs. Jiya Lal Sahgal (Class II) and Abdul Rashid Khan (U.S.S.) were transferred to No. 4 & 5 Party respectively from 1st September.

Messrs. Mohd. Najamuddin, B.A. (Class II) and B. N. Murthy, B.Sc., (Class II) were transferred to 'A' Company and No. 6 D. O. respectively from 16th September.

63. Areas surveyed.—

1,791 sq. miles of tertiary levelling.
1,859 sq. miles of 4-inch resurvey.

64. Field work was organized as follows.—

Camp (1).—Mr. O. D. Jackson (Class II), with Mr. Abdul Rashid Khan (U. S. S.) up to 31st December and Mr. B. N. Murthy, B.Sc., (Class II) from 1st January to 25th February and 16 Lower Subordinates, completed 828 square miles of 4-inch resurvey in Delhi Province and Rohtak district in sheets 53 C, D, G, & H.

At the end of February, 5 Lower Subordinates were transferred to the Geodetic Branch for levelling work in connection with the Bihār earthquake.

Camp (2).—Mr. Jiya Lal Sahgal (Class II), with Mr. N. M. Bopaiah (U. S. S.) up to 22nd February and Mr. B. N. Murthy, B.Sc. (Class II) thereafter, and 25 Lower Subordinates, completed 1,791 square miles of tertiary levelling in Delhi Province, Hissār and Rohtak districts and Dujāna and Jīnd States in sheets 44 O and 53 C, D, G, & H.

At the end of February 3 Lower Subordinates were transferred to the Geodetic Branch for levelling work in connection with the Bihār earthquake.

Camp (3).—Mr. Mahammad Najamuddin, B.A. (Class II), with Mr. B. N. Murthy, B.Sc., (Class II) up to 31st December and Mr. Abdul Rashid Khan (U. S. S.) thereafter and 15 Lower Subordinates, completed 1,031 square miles of 4-inch resurvey in Delhi Province, Hissār and Rohtak districts and Dujāna and Jīnd States in sheets 44 O and 53 C & D.

The country surveyed consists of flat cultivated plains interspersed with scrub, long grass and trees, particularly round villages and along roads and canals. In the south it is open, sandy and undulating.

Communications both by road and railway are good.

Drawing and computing Section.—Mr. N. D. Joshi, B.A. (U. S. S.) with Mr. M. L. Kohli (U. S. S.) and 10 Lower Subordinates completed the tertiary levelling computations of fiftyfive 4-inch sheets, the compilation of levelling books of fiftyone 4-inch sheets, the construction of 40 rough and 22 fair spot level charts and 40 rough contour sheets.

65. Miscellaneous.—On account of abnormal floods in Rohtak district during the month of September 1933, a large portion of the area to be surveyed was still under water when work commenced in October. Consequently there was a great deal of malaria in the country and, though all Lower Subordinates were supplied with mosquito nets and bamber oil, the party suffered a good deal from malaria.

The Bhakra Dam project survey having been suspended, the party khamal at Rohtak was closed down at the end of the field season. During the period the work is in abeyance the instruments and books of the party will be stored at the P. W. Dept. Central Workshops, Amritsar, and the equipment, furniture and tents at Husainiwāla.

66. Recess duties.—The fair mapping and computations of the field work were completed during the recess. The work was supervised by Messrs. O. D. Jackson, Jiya Lal Sahgal, Mohd. Najamuddin and N. D. Joshi, assisted by Messrs. B. N. Murthy, M. L. Kohli and Abdul Rashid Khan.

VI.—SURVEY REPORTS, GEODETIC BRANCH.

No. 1 Party.

Officer in charge.—Captain H. W. Wright, R.E.

67. General.—The party carried out operations in Ajmer-Merwāra Province, in the Central India, Punjab States, Rājputāna and Western India States Agencies and in Gwalior State in sheets 45 C, D, G, H, K, L, M, and 55 A.

Both Jaipur and Jodhpur States contributed at the full rate for surveys carried out for them and Būndi State made a very small contribution.

The field headquarters of the party moved from Ajmer and, by permission of H. H. the Mahārāja of Udaipur (or Mewār) State, opened at Udaipur on 19th October and closed there on 2nd April at the conclusion of the field work.

Personnel.—The field strength of the party was 1 Class I, 4 Class II and 4 Upper Subordinate Officers, 34 Lower Subordinates and 5 soldier surveyors under training.

68. Areas surveyed.—

Triangulation	...	... 10,788 square miles.
½-inch original survey	...	... 7,488 „ „
1-inch original survey	...	... 1,677 „ „

69. Field work was organised as follows:—

Camp (1).—Mr. A. A. Graham (Class II) with 6 surveyors completed the original survey of 2,109 square miles on the ½-inch scale in the states of Jaipur and Patiāla in sheet 45 M.

The area covered the northern Arāvalli mountain range on the east, and extended to sandy desert country on the west.

Camp (2).—Mr. B. B. Kutappa (U. S. S.) was in charge of a training camp of 6 Lower Subordinates, who completed 537 square miles of ½-inch and 267 square miles of 1-inch original survey in Ajmer-Merwāra Province and the states of Kishangarh, Shāhpura and Udaipur in sheet 45 K, an area which was mostly flat.

Camp (3).—Mr. T. M. C. Alexander (Class II) and 11 surveyors completed 4,367 square miles of ½-inch original survey in the states of Bhopāl, Dewās (Senior and Junior), Gwalior, Indore, Khilchipur, Narsinghgarh and Rājgarh in sheet 55 A, an undulating area, slightly hilly in parts.

Camp (4).—Mr. J. B. Lal (Class II) and 11 surveyors completed 475 square miles of ½-inch and 1,410 square miles of 1-inch original survey in the states of Jodhpur, Sirohi and Udaipur in sheet 45 G. The Jodhpur areas were mostly plains and the remainder high Arāvalli mountains and uplands rising to 4,000 feet.

Triangulation.—Mr. J. C. Ross (Class II) triangulated 2,154 square miles in sheet 45 C, Mr. B. P. Rundev (U. S. S.) 2,163 square miles in sheet 45 D, Mr. I. D. Suri (U. S. S.) 2,163 square miles in sheet 45 H, Mr. M. W. Kalappa, B.A. (U. S. S.) 2,163 square miles in sheet 45 L and 1st class surveyor Najmul Husain 2,145 square miles in sheet 45 C.

The total area triangulated was 10,788 square miles falling in the states of Gwalior, Indore, Jodhpur, Pālanpur, Sirohi, Tonk and Udaipur.

The country triangulated was in general open and hilly and included the highest parts of the Arāvalli range.

70. Recess duties.—Fair mapping was distributed in 4 sections under Messrs. A. A. Graham, T. M. C. Alexander, Jugal Behari Lal and B. B. Kutappa.

Triangulation computations were completed by a section under Mr. J. C. Ross.

No. 20 (Cantonments) Detachment.

Officer in charge:—{ Mr. L. Williams, M.B.E., to 17-10-33.
„ O. N. Pushong, from 18-10-33.

71. General.—The detachment resurveyed cantonments and their bāzārs on the 16-inch and 64-inch scales respectively, as required by the Engineer-in-Chief and Army Department.

The field season commenced on 8th November 1933 and closed on 10th April 1934, field headquarters remaining throughout at Dehra Dūn.

Personnel.—The field strength, excluding the officer in charge, was 2 U. S. officers and 31 Lower Subordinates including 5 draftsmen and 3 computers employed at field headquarters. Three surveyors were temporarily transferred to No. 15 Party (Bihār Levelling) at the end of March 1934.

72. Areas surveyed.—

16-inch re-survey.

Allahābād Cantonments	...	... 5690·56 acres.
Fyzābād „	...	... 5783·10 „
Shāhjahānpur „	...	... 2950·90 „

The above areas include overlaps.

64-inch re-survey.

Allahābād Cantonment Bāzārs	...	... 8·94 acres.
Fyzābād „ „	...	... 10·70 „
Shāhjahānpur „ „	...	... 5·20 „

73. Field work was organised as follows:—

Camp (1) with headquarters at Allahābād under Mr. J. A. Cabral, with 7 surveyors, 1 traverser and 1 leveller (for a short period), was allotted the detail survey of Allahābād Cantonments and advance traversing of Barrackpore and Ishapore.

Camp (2) with headquarters at Fyzābād under Mr. Bakhshi Harnam Singh, with 11 surveyors, 2 traversers and 1 leveller (for a short period), was allotted the detail survey of Fyzābād and Shāhjahānpur and advance traversing of Dehra Dūn Cantonments.

74. Traversing and Levelling.—3·2 linear miles were traversed in connection with changes in boundaries for the current season's survey and 154·5 linear miles of traversing and 104·6 linear miles of levelling were completed for next season's survey.

The boundary of Dove Dale estate in Landour was fixed and located for demarcation by traversing, at the request of the Cantonment Executive Officer.

75. Recess duties.—Fair mapping was allotted to two main sections during recess under Messrs. J. A. Cabral and Bakhshi Harnam Singh.

A small section of 5 draftsmen under the supervision of the officer in charge was employed throughout the field season to deal with arrears of mapping.

Twentynine sheets on the 16-inch scale and 11 sheets on the 64-inch scale, of Meerut, Jhānsi and Rānikhet cantonments and bāzārs, and 3 sheets on 64-inch scale, of Allahābād, Fyzābād and Shāhjahānpur bāzārs, were completed and sent for publication.

The computations of the traversing and levelling carried out in the season were also completed during recess.

VII.—SURVEY REPORTS, EASTERN CIRCLE.

DIRECTOR:—{Colonel J. D. Campbell, D.S.O., to 5-5-34. Lt.-Colonel C. M. Thompson, I.A., from 6-5-34 to 14-6-34. Major L. H. Jackson, I.A., from 15-6-34.

76. Summary. The units administered by the Eastern Circle were Nos. 4, 5 and 12 Parties, and No. 5 Drawing Office.

The Director, Eastern Circle, also acted as technical adviser to the Government of Assam.

77. Areas surveyed.—

487 sq. miles of ½-inch original survey.
4,816 sq. miles of 1-inch original survey.
1,386 sq. miles of 1½-inch original air survey.
5,354 sq. miles of supplementary survey.

78. Air Survey.—The survey of Tripura State and portions of sheet 79 M was this year carried out by a combination of air and ground topographical methods, a detailed account of which is given in No. 12 Party's report. In spite of the abnormal conditions of this year's work, there can be no doubt that the experiment was a great success and that air survey offers the only really economical solution to the problem of surveying low lying jungle country.

The utilization of the 3-inch air survey compilations in future surveys for the preparation of large scale forest and other maps is a possibility yet to be explored.

79. Training.—Two Class I Officers on probation joined No. 4 Party in January for training.

No pupils were recruited during the year under report.

80. Special.—The Director, Eastern Circle, inspected No. 6 (S.I.) Independent Party in the field.

No. 4 Party.

Officer in charge.—Mr. D. K. Rennick, M.B.E.

81. General.—Original and Supplementary surveys of 5,400 square miles on the 1-inch scale were carried out in sheets 72 C and D and 73 C in Bihār and Orissa, Eastern States and the United Provinces.

The field headquarters of the party opened at Gulzarbāgh, Patna, on the 16th November and closed on the 16th April.

82. Personnel.—The field strength of the party was 1 Class I, 4 Class II and 6 Upper Subordinate Officers, 38 Lower Subordinates and 4 soldier surveyors in their second period of training.

Lieutenants C. A. Biddle, R.E., and D. E. O. Thackwell, R.E., joined the party in the field on the 22nd January.

Two surveyors were transferred to No. 12 Party from 7th March.

Mr. S. C. Chatterjee, B.Sc. (U.S.S.) was transferred to Calcutta, from 1st May.

83. Area surveyed.—

46 sq. miles of 1-inch original survey.
5,354 sq. miles of 1-inch supplementary survey.

84. Field work.—The 20 sheets surveyed were distributed as follows:—

Camp (I).—Mr. C. T. Hurley (Class II), with Mr. Mohabat Ali (U.S.S.) and 8 surveyors, completed the 1-inch supplementary survey of 1,081 square miles in sheets 72 D/1, 5, 9 & 13 in the Gaya and Shāhābād districts.

This area is traversed by the Grand Chord line of the East Indian Railway, passing over the Son bridge, the longest in India.

The Grand Trunk Road runs through the western portion of this area, and there is another good metalled road branching north from the Grand Trunk Road. There are several motorable unmetalled and canal fair-weather roads.

Camp (II).—Mr. F. M. Hawley (Class II), with 5 surveyors, reinforced later by Mr. U. D. Mamgain (U.S.S.) and 5 surveyors, completed 46 square miles of 1-inch original survey and 768 square miles of 1-inch supplementary survey in sheets 73C/3 and 72C/6 and 10 in Sambalpur, Sāran and Shāhābād districts of Bihār & Orissa, Bāmra and Rairākhol States of the Eastern States Agency and Ballia district of the United Provinces.

Densely wooded hills and cultivated plains with intervening *sal* forests were the principal features of the country in sheet 73 C/3. The Ganges River and the East Indian Railway run through the northern portion of sheets 72 C/6 and 10 from west to east, and there are a few metalled roads and several unmetalled fair-weather roads.

Camp (III).—Mr. M. M. Ganapathy, B.A. (Class II) with Mr. A. P. Datta, B.Sc. (U.S.S.) and 9 surveyors completed 1,083 square miles of 1-inch supplementary survey in sheets 72 D/10, 11, 14 and 15 in the Gaya and Hazāribāgh districts.

The Grand Trunk Road passes through the northern portion of this area. There are two good metalled roads joining the Grand Trunk Road, and a few motorable fair-weather roads.

Camp (IV).—Mr. Abdul Ahad, B.Sc. (Class II), with Mr. N. C. Naug (U.S.S.) and 8 surveyors completed the 1-inch supplementary survey of 1,077 square miles in sheets 72 C/3, 4, 7 and 8 in Gaya and Shāhābād districts. There are three good metalled roads and many motorable fair-weather and canal roads in the area.

Camp (V).—Mr. S. C. Chatterjee, B.Sc. (U.S.S.), with Mr. S. B. P. Mathur, B.Sc. (U.S.S.) and 8 surveyors, completed the 1-inch supplementary survey of 1,077 square miles in sheets 72 C/11, 12, 15 and 16 in Gaya, Patna and Shāhābād districts.

On completion of the above in March, Mr. Chatterjee and 10 surveyors carried out the 1-inch supplementary survey of 268 square miles in 72 C/2 falling in the Shāhābād district of Bihār and Orissa and the Ballia district of the United Provinces.

Triangulation and Traverse.—The party did no triangulation this season.

Mr. U. D. Mamgain, B.Sc. (U.S.S.) completed the traverse of 235 linear miles covering an area of 1,614 square miles in sheets 72 G/10, 11, 12, 14, 15 and 16, with the object of ascertaining the accuracy in

geographical position of the village boundary-trijunction pillars and whether they could be utilised as frame-work without further traverse; also to provide height data for the detail survey.

85. Description of country.—The whole area with the exception of sheet 73 C/3, already described, lies in the Gangetic plain. The country is open, intensively cultivated and densely inhabited, and a great portion of it on either side of the Son River is irrigated by the canals which take off it at Dehri.

In the south, extending eastwards to the Hazāribāgh range, there are steep, rocky and intricate hills covered with dense thorny scrub. Most of the country in this region was not easily sketchable and work was somewhat slow. Huge boulders, piled loosely one on top of the other are a remarkable feature of these hills.

The country rises from the Gangetic plain in the north to an altitude of more than 1,500 feet in the Hazāribāgh hills in the south.

86. Miscellaneous.—

Health.—The health of the party was generally very satisfactory. Some of the men, who were working in the Sambalpur district suffered from malaria but soon recovered normal health when moved elsewhere.

At the outset most of the party was inoculated against cholera.

In March and April smallpox was prevalent. Full advantage was taken of the numerous vaccination depots in the districts and there was only one seizure from this disease.

One khalasi was drowned in a main distributary of the Arrah canal.

Weather.—The weather remained fine throughout. In March and April conditions were somewhat trying owing to strong winds and dust.

Bihār Earthquake.—The serious earthquake which occurred on the 15th January 1934 affected the party area only to a small extent, the main intensity being further north (*vide* para. 114).

87. Recess duties.—The party was organised in four drawing sections under Messrs. Hurley, Hawley, Ganapathy and Abdul Ahad and a computing section under Mr. U. D. Mamgain.

When Mr. Abdul Ahad proceeded on leave Mr. Mohabat Ali (U.S.S.) took over charge of his section.

The mapping and computations were completed by the end of recess.

No. 5 Party.

Officer in charge.—Captain I. H. R. Wilson, R.E.

88. General.—The Party continued surveying the eastern part of the Central Provinces and in the Eastern States Agency on the 1-inch scale, and completed sheets 64 D & G and part of 64 H.

Field headquarters were at Raipur, the field season opening on November 2nd and closing on April 17th.

89. Personnel.—The field strength consisted of the officer in charge, 3 Class II and 3 U. S. officers (one under training), 21 surveyors, 2 traversers, 3 computers, 3 clerks and 1 store-keeper.

90. Areas surveyed.—

4,167 sq. miles of 1-inch original Survey.

91. Field work.—The 15 sheets for survey were divided between 3 camps as follows:—

Camp (1).—Mr. K. C. Gosain (Class II), assisted by Mr. G. S. Sidhu (U. S. S.) and 7 surveyors, carried out the original survey of 1,113 square miles in sheets 64 D/9, 10, 13 & 14, in Drug, Chānda and Bhandāra districts and Nāndgaon State. The country consisted of jungle clad hills with fairly open and partially cultivated valleys.

Mr. Gosain fractured his wrist in early January and exchanged with Mr. Hastir, taking charge of *Camp (3)*, where travelling was easy and he could carry on while his arm was in a splint.

Mr. Sidhu was also transferred to *Camp (3)* to give him experience of surveying in open flat country. His place was taken by Mr. I. H. Naquvi (U. S. S.).

One surveyor was transferred to Frontier Circle at the end of January but the camp was later reinforced by 2 surveyors from *Camp (3)*.

Camp (2).—Mr. M. A. Khan (Class II) assisted by Mr. G. H. Khan (Class II) and 8 surveyors carried out original survey of 1,668 square miles in sheets 64 G/4, 8 & H/1, 2, 5 & 6, in Drug and Raipur districts and Khairāgarh, Nāndgaon and Kānker States.

In two sheets there were thick jungle covered hills but the rest of the country consisted of flat open cultivation.

Mr. G. H. Khan went on sick leave in January as the result of concussion of the brain after a motor-bus accident.

One surveyor was transferred to Frontier Circle and one to No. 12 Party, but the camp was later reinforced by 2 surveyors and 1 traverser (who was employed on planetabling) from *Camp (3)*.

Camp (3).—Mr. R. N. Hastir (Class II), assisted by Mr. I. H. Naquvi (U. S. S.) and 5 surveyors, 2 traversers and 2 computers (including 1 traverser & 2 computers under training), carried out original survey of 1,386 square miles in sheets 64 G/7, 11, 12, 15 & 16 in Raipur and Drug districts. The country throughout consisted of flat open cultivation.

Messrs. Hastir and Naquvi later moved to *Camp (1)* and were relieved by Messrs. Gosain and Sidhu. Towards the end of the season 4 surveyors and 1 traverser were sent to reinforce *Camp (1)* & *(2)*.

Traversing.—Traverser Palakdhari Singh traversed 175 linear miles in Raipur District and Kānker and Bastar States to supplement existing triangulation in sheets 64 H/12, 14, 15 & 16. The country was hilly and heavily jungled.

At the request of the Agent to the Governor General, Eastern States Agency, some 4 miles of disputed boundary between the States of Khairāgarh and Chhuīkhadān was relaid by the Officer-in-charge in accordance with the boundary shown on the old 1873 map. After the boundary pillars of the relaid boundary had been built, the latter was traversed by Traverser Palakdhari Singh.

92. Miscellaneous.—The health of the Party throughout the field season was excellent, and there were no casualties except for the injuries to the 2 officers already referred to and the accidental drowning

of one local khalasi. The weather was good except for the last three weeks which were unusually hot, even for the Central Provinces.

93. Recess Duties.—Fair mapping was divided into three sections under Messrs. M. A. Khan, G. H. Khan and R. N. Hastir. Mr. K. C. Gosain was in charge of the Computing Section, as well as of Mr. G. H. Khan's Drawing Section for the first two months, while the latter was still on sick leave.

The 15 sheets surveyed during the field season and all computations were completed during recess.

No. 12 Party.

Officer in charge.— Captain G. H. Osmaston, M.C., R.E., to 20-10-33.
Lt.-Col. E. O. Wheeler, M.C., R.E., from 21-10-33 to 3-3-34 and from 23-7-34.
Lieut. C. A. K. Wilson, R.E., from 4-3-34 to 22-7-34.

94. General.—The survey of Tripura State of Bengal was completed during the year. Last year this area, being low undulating jungle, presented the greatest difficulty to ordinary ground methods, and the remaining sheets in 79M containing portions of Noākhāli district and Chittagong Hill Tracts as well as Tripura State, were therefore completed by combining air and ground survey. The portion of Tripura State falling in 79N was also surveyed in the same way.

The remainder of Tripura State and the portions of the Miani Headwater and Kāsālang Reserved Forests falling in sheet 84 A/N.W. were surveyed on the 1-inch scale by ground methods, and the rest of the sheet which is in Lushai Hills district, Assam, surveyed on the ½-inch scale.

The field headquarters of the party opened at Comilla on 16th November and closed on 26th May.

Personnel.—The field strength of the party consisted of 2 Class I officers (one for half the season), 3 Class II, 5 Upper Subordinate officers and 37 Lower Subordinates. Of this strength 21 were planetabling throughout the season; the air work was commenced early in February and employed 4 officers and an average of 14 surveyors.

95. Areas surveyed.—

½-inch original survey	...	...	487 square miles.
1-inch original survey	...	...	603 ,, ,,
1½-inch original air survey	...	...	1,386 ,, ,,

Boundary Survey.—In the course of the survey of Tripura State in 84 A/NW, an adjoining area of eight square miles was surveyed in connection with the demarcation of the boundary between Tripura State and the Lushai Hills district. Mr. K. L. Dhawan (Class II) accompained the boundary commission, and an appreciation of his services was received from the Superintendent, Lushai Hills.

Air Survey.—1,386 square miles in sheets 79 M/10, 11, 12, 15 and 16 and a portion of 79 N/9 were surveyed by combining air and ground survey methods.

The country contained *a little* permanent cultivation in the wider valleys, and considerable *jhūms* in the low jungle clad hills and undulat-

ing ground of which the area *mostly* consists. The jungle was mainly bamboo, with some heavy virgin jungle in parts, notably in the Chingri and Fenny river valleys.

Air photography was carried out in November by the Indian Air Survey and Transport Coy. Ltd., flying at about 15,000 ft. with a Williamson "Eagle II" automatic film camera fitted with 8¼-inch lens, the scale of the photos being therefore roughly 3 inches to one mile.

The air survey control was the normal topographical triangulation carried out previously, together with the previous season's ground survey on the northwestern and a portion of the eastern margins, and on the south a few points of detail of the old (1908) 1-inch sheet and one theodolite traverse station.

The air survey compilation was carried out in No. 18 (Air Survey) Party by the "Arundel" principal point (radial line) method, on the 3-inch scale. Detail, main ridge lines and prominent tops were surveyed, leaving contouring to be done by ground methods. Many more minor feeder streams were surveyed than actually necessary for the final map, to assist the ground surveyor to locate minor ridges and sketch in contours.

The ground work commenced at the begining of February, as soon as the compilations from the air photographs had been received from No. 18 Party, and consisted of checking and classifying detail, collecting names and contouring. It was carried out on 1½-inch scale blue reductions of the 3-inch compilations from air-photos, on which the trigonometrical control had been plotted.

A few fixings from this control served to show that there was no general shift in the air work, and to establish a network of heights from which contouring could be carried out in the ordinary way. Contouring was much facilitated and expedited by the fact that all streams, all main ridge lines and many hill tops already appeared on the blue print of the compilation.

Four trained air surveyors, transferred from No. 18 Party in February, were able to combine ground and stereoscopic contouring in the field. Checking of detail consisted mainly of entering huts, which were obscured in the photographs by trees and consequently omitted in the compilation, and in deleting huts shown on the air compilation, which when examined on the ground, were found not to be of a permanent nature. Very few actual corrections to detail were found necessary.

The monthly outturn by this method of survey as compared with ordinary ground survey was 29·1 sq. miles as against 7·7 sq. miles and the full cost-rate per square mile including photography and compilation was Rs. 41 as against Rs. 50.

The advantage of air over ground methods for this kind of country would be still further increased with more experience; for example, it was found very difficult at first to accustom to this method surveyors who had been used to surveying *de novo* or to *revision* work on blue prints, and to persuade them to accept as accurate the streams surveyed from the air.

96. Field work.—

Camp (1) Mr. K. L. Dhawan (Class II) with 21 surveyors carried out 603 square miles of 1-inch original survey in sheets 84 A/1, 2, 5 and 6

and 487 square miles of ½-inch original survey in sheet 84 A/NW. This work was finished late in April and Mr. K. L. Dhawan and 13 surveyors were then transferred to *Camp* (*2*).

Camp (*1*) also carried out eight square miles of 1-inch survey in connection with the demarcation of the Tripura State boundary in sheet 84 A, referred to in para. 95.

Camp (*2*) Mr. F. J. Grice (Class II) with 13 surveyors carried out 1,386 square miles of 1½-inch original air survey (ground work) in sheets 79 M/10, 11, 12, 15 and 16 and 79 N/9.

Lieut. C. A. K. Wilson, R.E. and Surveyor S. N. Sharma fixed by planetable 481 heights in 79 M/15 and 16 prior to the arrival of *Camp* (*2*) in the field.

Mr. J. C. Berry (Class II) and four surveyors trained in air survey joined *Camp* (*2*) from No. 18 Party in February.

97. Description of country.—The area under survey varied from intricate low hills, covered with dense bamboo jungle and broken up by tortuous streams in the south, to the heavily forested ridges running up to 3,000 feet and the low valleys of the Lushai Hills in the east. The area also included a part of the Miani Headwater and Kāsālang Reserved Forests of the Chittagong Hill Tracts, uninhabited and almost impenetrable tracts of dense timber and bamboo jungle, with hills reaching a height of 2,000 feet.

Jhūms (patches of temporary cultivation on steep hill-sides) are numerous in western Tripura State and enabled planetable fixings to be made at frequent intervals without much cutting. Further east the population is sparser, *jhūms* less numerous and much more clearing is necessary. In the reserved forests and in parts of the Lushai Hills there are no *jhūms* at all, and survey is very slow and costly.

The bamboo which overruns most *jhūms* as soon as they are abandoned, as is customary after a couple of years cultivation, will grow as much as 40 feet in one year; consequently only the current year's *jhūms* help the surveyor in making fixings and seeing the country. Survey in areas without *jhūms* was carried out by covering the area with a net work of compass traverses, usually along streams and ridges, controlled by occasional fixings, which invariably required much arduous clearing.

Movement in all parts of the area was difficult, and particularly so in the reserved forests and the Lushai Hills, where there are practically no paths at all and progress can only be made by wading along streams and making use of elephant tracks on the ridges. The surveyors in these areas had the greatest difficulty in establishing and maintaining their camps.

98. Miscellaneous.—

Health.—*Camp* (*1*) maintained a fairly good standard of fitness, but the low unhealthy area in which the surveyors of *Camp* (*2*) had to work till late in May caused a high percentage of sickness.

The death of Jemadar Ram Rattan, I.M.D., in Tripura State in February while alone on tour in Camp (1) was an unexpected disaster. The specific fever that caused his death could not be diagnosed for certain, but was thought to have been blackwater or enteric fever.

Weather.—The weather remained fair until the middle of April, after which thunderstorms caused serious delay to the work.

Fauna.—Feathered game was exceedingly rare, but elephants are to be found, mainly in the east of the area under survey.

A large rogue elephant, which had killed several men during the last few years, was shot by the Officer in Charge at Nutan Bāzār on the 18th March. It stood 10 feet 4 inches at the shoulder, which is equal to the record for a *makhna*. This is belived to be the same animal which raided the Director's camp last field season (para. 91 of 1933 General Report).

Terrorist activity.—British officers in Comilla were required by Station Orders to carry arms and go about accompanied by an armed orderly. Otherwise survey operations were unaffected by the recent terrorist activity in Bengal.

99. Recess Duties.—The party was organised in two drawing sections under Mr. J. C. Berry (Class II) and Mr. K. L. Dhawan (Class II). Mr. F. J. Grice (Class II) generally supervised the work of both sections.

The nine 1-inch sheets surveyed during the field season were fair drawn during recess and sheet 84 A/N.W. was handed over to No. 5 Drawing Office for fair drawing, on receipt of the drawing (blue prints) from Calcutta.

Sheets 34 N/12 and 16 received from the Frontier Circle were also fair drawn in this party.

VIII.—SURVEY REPORTS, INDEPENDENT PARTIES.

100. Nos. 6 (South India) and 10 (Burma) Independent Parties were administered directly by the Surveyor General. Their mapping and survey areas were approximately the same as those of the former Southern and Burma Circles respectively, abolished in 1932.

No. 6 (South India) Party.

Officer in charge.—Major W. J. Norman, M.C., R.E.

101. General.—The party continued the 1-inch survey of the Ganjām and Vizagapatam Districts of Madras, and for the first time for several years the whole party was concentrated in one area.

Field head-quarters opened in Waltair on 15th November 1933 and closed on 18th April 1934, field work continuing till May.

Triangulation in advance for subsequent survey on the 1-inch scale was carried out in the Ganjām and Vizagapatam Districts of Madras, in the Raipur District of the Central Provinces, and in Bastar and Kālāhandi States of the Eastern States Agency.

In addition to the field work, a permanent drawing section was employed on compiled mapping and colour patterns in Bangalore.

102. Personnel.—The strength of the party was 1 Class I, 4 Class II and 6 Upper Subordinate Officers and 63 Lower Subordinates.

In addition, 1 Class I Officer and 1 Lower Subordinate were employed in the party for the field season only.

103. Areas surveyed.—

6,488 square miles of triangulation for subsequent 1-inch survey.

4,884 square miles of 1-inch original survey.

104. Field work was organized as follows:—

Camp I. Mr. Natesan (Class II) with 8 to 13 surveyors surveyed 1,299 square miles in sheets 65 N/9, 13, 14, 74 B/2, 6 & 10.

Camp II. Mr. Nangia (Class II) with 12 to 13 surveyors surveyed 1,408 square miles in sheets 65 N/1, 2, 5, 6 & 10.

Camp III. Mr. Nair (Class II) with 12 to 10 surveyors surveyed 1,354 square miles in sheets 65 N/3, 4, 7, 8 & 12.

Camp IV. Mr. Azim, I.D.S.M., (U. S. S.) with 7 to 5 surveyors surveyed 823 square miles in sheets 65 N/11, 15, 16, 74 B/3, 4 & 7.

Triangulation. Lieut. Sams (Class I), Messrs. Mustafa, Shamanna, Fernandez (U. S. S.) and Surveyor Narasinga Rao triangulated sheets 65 I/1, 5, 9, 13, 65 M/1, 5, 9, 13, and 74 A.

The Party was inspected in the field by the Director, Eastern Circle.

105. Description of the country.—One third of the area surveyed comprised the hills of the Eastern Ghāts rising to about 4,000 feet. Although some of these hills were jungle covered, they were not as a whole difficult to survey.

The remainder of the area was easy to survey as it comprised the coastal plain in which were many dominating isolated hills.

106. The health of the party was again unsatisfactory. The hilly country is notoriously unhealthy and the surveyors were kept away from there until the end of January, by which time the risk of malaria was reduced. In spite of this and although every precaution possible was taken, nearly every surveyor in the area developed malaria. The surveyors seemed to have little or no resistance to the disease and little power of recovery once they had developed it.

107. Recess duties.—The nineteen 1-inch sheets of the current programme were mapped during recess by 4 sections under Messrs. Natesan, Nangia, Nair and Azim. Each of these sections also completed one compiled ½-inch sheet of the same area as was being mapped on the 1-inch scale.

In addition, two sections under Messrs. Drake (Class II) and Muthanna (U. S. S.) were employed for the whole year in Bangalore on compiled mapping. The arrears of compiled mapping were eliminated by the end of the year.

Each officer who triangulated did his own computations and, in addition, one section under Mr. Shamanna was employed during recess in adjusting triangulation and sorting old records.

No. 10 (Burma) Party.

Officer in charge.—{Major L. H. Jackson, I.A., to 2-6-34.
Mr. J. McCraken, M.B.E., from 3-6-34.

108. General.—The party continued surveys on the 1-inch and ½-inch scales in Upper Burma and Assam. The field headquarters opened at Mawlaik on 20th November and closed on 6th April.

Personnel.—The field strength was one Class I, 3 Class II and 4 U. S. Officers and 35 Lower Subordinates.

In addition a Drawing Section consisting of 15 draftsmen and surveyors and 1 computer, in charge of Mr. McCraken (Class II), remained in Maymyo to carry on the compiled mapping of the party.

109. Areas surveyed.—

10,248 square miles of triangulation for 1-inch and ½-inch detail survey;

4,379 square miles of ½-inch original survey;

1,550 square miles of 1-inch original survey;

94 square miles of 1-inch revision of modern 2-inch survey.

110. Field work was organised as follows:—

Camp 1.—Mr. F. W. Smith (Class II), assisted by Mr. Khan Muhammad (U. S. S.) and 17 surveyors, completed the 1-inch original survey of 1,000 square miles and 94 square miles of 1-inch revision of 2-inch modern surveys in sheets 84 I/11, 12, 15 and 16 in the Upper Chindwin and Shwebo districts of Burma. The country surveyed consists of densely wooded plains and low flat-topped hills. Communications are poor.

Camp 2.—Mr. C. P. E. Davenport (Class II) with 9 surveyors completed the ½-inch original survey of 3,314 square miles in sheets 84 E/NE, SE and 84 F/NE in the Chin Hills and Upper Chindwin districts of Burma and in Manipur State of Assam.

The country surveyed consists for the most part of high open hills rising to nearly 9,000 feet above sea-level. Communications are good, most routes being suitable for pack transport.

Camp 3.—Mr. D. N. Saha (Class II) with 9 surveyors completed the 1-inch original survey of 550 square miles and ½-inch original survey of 1,065 square miles in sheets 84 J/3 and 7 and 84 F/NW in the Chin Hills, Pakokku and Upper and Lower Chindwin districts of Burma and Lushai Hills district of Assam.

The country surveyed on the 1-inch scale consists of densely wooded plains and hills rising to about 4,000 feet above sea-level. Communications are poor. The ½-inch area consists of high open hills rising to about 8,000 feet with very fair communications.

Triangulation.—Messrs. A. K. Sen Gupta, H. K. Kar, A. K. Talapatra, U. On Ba and surveyor Iqbal Muhammad completed the triangulation of 10,248 square miles in sheets 84 D/NW & NE, 84 F/SW & SE, 84 G/NW, NE, SW & SE and 84 H/NW & NE, in the Akyab, Arakan Hill Tracts, Chin Hills and Minbu districts of Burma, the Lushai Hills district of Assam and Chittagong district of Bengal.

The triangulation was connected to the Manipur Meridional, the Chittagong and the Burma Coast Series.

111. Recess duties.—Fair mapping was divided into two sections under Messrs. F. W. Smith and D. N. Saha, and the computing section was in charge of Mr. C. P. E. Davenport. All surveys were fair mapped and computations completed during the year.

The Drawing Section, under Mr. J. McCraken, carried out compiled mapping throughout the year.

IX.—MISCELLANEOUS SURVEY REPORTS.

No. 15 Party (Triangulation and Levelling).

Officer in charge.—Captain G. Bomford, R.E.

112. Other work done by this party is described in paras. 33 and 34.

113. Pegu earthquake area.—120 miles of precise levelling and 112 miles of secondary levelling were completed in the area disturbed by the Pegu earthquake of 1930. The results provide some evidence that Pegu and its neighbourhood have sunk about 3 inches, but the evidence is not conclusive. Larger disturbances had been expected, and may possibly have occurred in a length of 10 miles north of Pegu where no old benchmarks were found, but all the benchmarks connected appear to have maintained their original heights surprisingly well.

The secondary levelling was paid for by the Government of Burma.

114. Bihār earthquake area.—500 miles of secondary, 270 miles of double tertiary levelling, and 1,200 miles of single tertiary, were carried out in the area disturbed by the Bihār earthquake of 1934, in order to provide data from which monsoon flooding could be predicted.

The secondary levelling followed old lines, and most benchmarks were found to have sunk between 2 and 4 feet relative to benchmarks at Bagaha which have presumably been little disturbed.

The work was paid for by the Government of Bihār.

Training School, Dehra Dūn.

Officer in charge.—Mr. M. M. Mudaliar, M.A.

115. *Class I Probationers.*—Lieuts. C. A. Biddle, R.E. and D. E. O. Thackwell, R.E. were attached to the Training School for a period of about 2 months, during which time they did 2-inch plane-tabling; thereafter they joined No. 5 Party for instruction in the field in the Central Provinces.

Class II Probationers.—Seven probationers were appointed in November and were put through a course of plane-tabling on the 4-inch and 2-inch scales with short periods for triangulation and traversing.

During the recess they received instruction in all branches of survey work.

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PART 4.—MAP PUBLICATION AND OFFICE WORK.

From 1st April 1933 to 31st March 1934.

X.—INTRODUCTION AND PERSONNEL.

116. Index maps Nos. 3 to 7, at the end of this Report, form the most important adjunct to *Part 4*, as they show the progress of publication to date for all standard series of modern maps, excluding transfrontier work.

117. Letter press.—Apart from *Sections X* (Introduction) and *XIV* (annual report of the Mathematical Instrument Office), *Part 4* is divided into three main Sections:—

Section XI shows all publications and map issues for the year.

Section XII shows all the fair drawing, whether completed for publication or still in hand, carried out by the various drawing offices and field parties.

Section XIII describes the work of the printing and miscellaneous offices, excluding that of the Computing and Tidal Party, whose work is of a geodetic character and is published in full in the annual Geodetic Report.

118. Personnel.—

Calcutta. Director, Map Publication.

Col. C. G. Lewis, O.B.E., to 4-11-33.
Lt.-Col. F. J. M. King, R.E., from 5-11-33.

Chief Draftsman—Mr. Amar Krishna Mitra, R.S.

No. 1 Drawing Office.

O.C. Mr. E. B. West, to 30-11-33.
,, ,, L. Williams, M.B.E., from 1-12-33.
II ,, C. S. McInnes, to 9-11-33.
,, ,, F. H. Grant, from 17-11-33.
,, ,, J. C. St. C. Pollett.
,, ,, A. F. Murphy.
,, ,, Dhirendra Nath Banarji, L.C.E.
,, ,, Duni Chand Puri, to 4-1-34.
,, ,, Bhupendra Nath Saha, M.Sc.
,, ,, Abdul Rashid Quraishi, B.A.
U.S. ,, Kodendra Ganapathy Mandanna.
,, ,, Girija Sonker Bagchi.
,, ,, Atul Chandra Maulick.
,, ,, Nirmal Chandra Sen.

Engraving Office.

Mr. A. R. J. Dalziel, Head Engraver.

Photo.-Litho. Office.

O.C. Major G. W. Gemmell, I.A.

Managers & Assistant Managers.

Mr. S. Colquhoun, Manager, Litho.
,, F. R. Vandyke, ,, Photo. to 7-2-34.
,, L. H. Mordue, Offg. Manager, Photo. from 8-2-34.
,, L. H. Mordue, *Asstt.* ,, Litho. to 7-2-34.
,, K. L. Dev, ,, ,, Photo. from 7-10-33.
,, K. L. Dev, ,, ,, Litho. from 8-2-34.
,, L. J. Vallis, ,, ,, Photo. to 6-10-33.
,, L. J. Vallis, ,, ,, Photo. from 8-2-34.

Map Record and Issue Office.

O.C. Mr. E. A. Meyer.

Mathematical Instrument Office.

Mr S. Woodhouse, Superintendent in charge.
,, R. C. Malcolm, F.R.M.S., F.R.Met. Soc., Asstt. Supdt.
,, A. Lacamp, Asstt. Supdt.

Dehra Dūn. Director, Geodetic Branch.

Colonel R. H. Phillimore, D.S.O., to 18-2-34.

Col. C. G. Lewis, O.B.E., from 19-2-34.

No. 2 Drawing Office.

O.C. Mr. V. W. Morton.
II ,, Moquimuddin Ansari.
,, ,, N. S. Harihara Iyer, from 21-8-33. (on leave to 20-8-33).
U.S. ,, A. A. S. Matlub Ahmad, to 31-12-33.
,, ,, Abdul Ghani Qureshi.

Forest Map Office.

C.D. Mr. O. N. Pushong, to 17-10-33.
,, ,, F. C. Pilcher, from 18-10-33 (attached to F. M. O. from 3rd to 17-10-33).
U.S. ,, B. B. Shome, to 20-12-33.
,, ,, A. A. S. Matlub Ahmad, from 1-1-34 to 14-2-34.

Computing & Tidal Party.

O.C. Captain G. Bomford, R.E., from 17-4-33 to 7-11-33.
,, Col. C. G. Lewis, O.B.E., from 8th to 25-11-33. (The charge was held by D. G. B. during the remaining periods).

Photo.-Zinco. Section.

Mr. S. C. Aratoon.

Letterpress Printing Section.

Mr. H. H. Williams.

Simla. Director, Frontier Circle.

Colonel S. W. Sackville Hamilton, D.S.O., to 29-11-33.

Col. C. G. Lewis, O.B.E., from 30-11-33 to 16-2-34.

Colonel S. W. Sackville Hamilton, D.S.O., from 17-2-34.

No. 6 Drawing Office.

O.C. Lt.-Col. F. B. Scott, I.A., to 17-10-33.
,, Lt.-Col. C. M. Thompson, I.A., from 18-10-33.

SURVEY SECTION.

II Mr. M. M. Mudaliar, M.A., to 3-11-33.
,, ,, Duni Chand Puri, from 20-2-34.
,, ,, Chowdhuri Mohd. Aslam, B.A.
U.S. ,, H. Narasimhamurti Rao, B.A.
,, ,, Vidya Dhar Chopra, to 31-8-33.
,, ,, Ghulam Hasan, from 19-10-33.
,, ,, Lalbir Singh, C.H.
,, ,, Abdul Rashid Khan, from 27-7-33 to 5-10-33.
,, ,, Mohd. Akbar, from 13-11-33 to 4-3-34.

ARMY SECTION.

Lieut. T. A. Whitmarsh.

Shillong. Director, Eastern Circle.

Colonel J. D. Campbell, D.S.O.

No. 5 Drawing Office.

O.C. Mr. P. Simpson, up to 7-12-33 and again from 8-3-34.
,, ,, P. C. Mitra, B.A., from 8-12-33 to 7-3-34.
II ,, P. C. Mitra, B.A., from 6th to 30-4-33, from 1-11-33 to 7-12-33 and again from 8-3-34.
,, ,, B. T. Wyatt, V.D., from 7-11-33.
,, ,, F. J. Grice, from 1-11-33 to 31-12-33.
,, ,, C. T. Hurley, up to 31-10-33.
U.S. ,, P. C. Sen Gupta, B.Sc., from 1-11-33.
,, ,, Janam Raj Chibbar.
,, ,, Narayana Chandra Ray, from 1-11-33 to 31-12-33.
,, ,, Muhammad Muzaffar Shah.

Bangalore. No. 6 (South India) Party.

O.C. Major W. J. Norman, M.C., R.E.
II Mr. A. J. A. Drake, D.C.M.
,, ,, E. N. Natesan, B.A.
,, ,, M. D. Nangia, B.A.
,, ,, M. R. Nair, B.A.
U.S. ,, Muhammad Abdul Azim, I.D.S.M.
,, ,, K. B. Muthanna.
,, ,, Muhammad Mustafa.
,, ,, A. Shamanna.
,, ,, C. H. Fernandez.
,, ,, Mohd. Amir Faruquie, B.A.

Maymyo. No. 10 (Burma) Party.

O.C. Major L. H. Jackson, I.A.
II Mr. J. McCraken, M.B.E.
,, ,, F. W. Smith.
,, ,, C. P. E. Davenport.
,, ,, D. N. Saha.
U.S. ,, P. C. Sen Gupta, B.Sc., to 15-9-33.
,, ,, Khan Muhammad, C.H.
,, ,, A. K. Sen Gupta.
,, ,, H. K. Kar, from 9-9-33.
,, ,, A. K. Talapatra.
,, ,, U. On Ba.

XI.—PUBLICATIONS AND ISSUES.

119. Publications.—The publications of the Department for the year are shown in the following three tables, of which Table I shows map publications at the various presses, Table II shows the progress made in publication of modern topographical maps, and Table III shows the more important letterpress publications.

Table I *(a)*—Maps published at Calcutta, during the year 1933-34.

Class of maps.	Scale.	New publications.	Revised editions, new editions and reprints.	Number of copies printed.	Value. Rs.
		Departmental.			
GENERAL MAPS.					
Maps of India	Various	1	7	10,355	11,633
GEOGRAPHICAL MAPS.					
Southern Asia Series ...	1:2 million	2	2	2,384	5,606
India and Adjacent Countries Series	1:1 million	...	8	5,711	8,864
Carte Internationale du Monde	1:1 million	...	5	1,240	2,789
TOPOGRAPHICAL MAPS.					
Quarter-inch, Modern ...	1″= 4 miles	14	24	20,154	30,783
„ (Prely.) ...	Ditto	...	3	654	1,029
„ (Provl.) ...	Ditto	...	16	4,729	5,116
Half-inch, Modern ...	1″=2 miles	74	26	48,438	95,880
One-inch, Modern ...	1″=1 mile	98	113	136,237	2,10,645
„ (Prely.) ...	Ditto	11	3	6,505	9,409
„ (Provl.) ...	Ditto	...	3	1,168	1,437
Old style maps	Various	...	17	2,905	4,039
SPECIAL MAPS.					
Manœuvre and Radius maps ...	1″=1 mile	...	4	3,842	12,855
Provincial maps	Various	...	3	1,408	3,620
City & Town Guide maps ...	Ditto	3	5	6,062	11,532
Index maps	Ditto	1	61	32,923	6,609
Miscellaneous maps ...	Ditto	14	14	13,607	3,197
Total ...	.....	**218**	**314**	**298,322**	**4,25,043**
		Extra-departmental.			
Maps	Various	191	42	98,257	28,058
Plans and diagrams ...	Ditto	179	36	66,085	6,378
Illustrations	.....	73	1	22,741	3,782
Miscellaneous	.....	13	8	75,417	2,917
Total ...	.....	**456**	**87**	**262,500**	**41,135**
Grand Total ...	.....	**674**	**401**	**560,822**	**4,66,178**

Table I *(b)*—Maps published at Dehra Dun.

Class of maps.	Scale.	New publications.	Reprints and new editions.	Number of copies printed.	Value. Rs.
		Departmental.			
Cantonment maps ...	Various	19	24	2,758	3,302
Forest maps ...	,,	24	...	900	1,427
Miscellaneous ...	,,	67	35	43,952	12,158
Total ...	...	**110**	**59**	**47,610**	**16,887**
		Extra-departmental.			
Maps	Various	85	2	20,505	18,278
Plans and diagrams ...	,,	9	3	8,128	2,783
Charts	,,	24	22	4,933	2,773
Forest maps ...	,,	16	...	2,464	4,901
Total ...	...	**134**	**27**	**36,030**	**28,735**
Grand Total ...	...	**244**	**86**	**83,640**	**45,622**

Table I *(c)*—Maps published at Quetta.

Class of maps.	Scale.	New publications.	Reprints and new editions.	Number of copies printed.	Value. Rs.
		Departmental.			
Maps	Various	37	13	402	1,267
Plans and diagrams ...	,,	8	2	91	53
Charts / Forms	,,	43	28	8,629	2,520
Total ...	...	**88**	**43**	**9,122**	**3,840**
		Extra-departmental.			
Maps	Various	7	18	2,700	733
Plans and diagrams ...	,,	60	4	5,566	1,111
Charts / Forms	,,	14	1	2,247	840
Total ...	...	**81**	**23**	**10,513**	**2,684**
Grand Total ...	...	**169**	**66**	**19,635**	**6,524**

Table I *(d)*—Maps published at Murree and Risalpur Cantonment.

Class of maps.	Scale.	New publications.	Reprints and new editions.	Number of copies printed.	Value. Rs.
	Departmental.				
Maps	Various	...	...	3,647	4,401
Plans and diagrams ...	...	...	...	25	
Charts, Forms	Various	...	...	5,714	
Total ...	...	...	...	**9,386**	**4,401**
	Extra-departmental.				
Maps	Various	...	...	2,410	1,410
Plans and diagrams ...	„	...	...	500	
Charts, Forms	„	...	...	1,248	
Total ...	...	...	...	**4,158**	**1,410**
Grand Total ...	...	...	...	**13,544**	**5,811**

Table II.—Abstract of Modern Topographical Maps.

	One-inch maps.	Half-inch maps.	Quarter-inch maps.
Topographical maps published in 1933-34	98	74	14
Do. do. published in previous years	3,351	913	315
Total published ...	**3,449**	**987**	**329**
Number of sheets in India ...	**6,218**	**1,630**	**450**

NOTES.—

Calcutta.—In addition to the work shown in Table I(*a*), 105,929 copies of 348 maps were gridded during the year.

Dehra Dūn.—In addition to the work shown in Table I(*b*), 2,574 prints of 511 originals, consisting of plane-table sections, triangulation charts and pamphlets, and forest maps were printed.

Table III.—Letterpress publications.

(a) PUBLISHED AT CALCUTTA.

1. General Report of the Survey of India, 1931-32. (450).*
2. Ditto. ditto. ditto. 1932-33. (475).
3. Confidential Supplement to the Survey of India General Report, 1931-32. (125).
4. Ditto. ditto. ditto. 1932-33. (125).

*Numbers in brackets after each item denote the number of copies printed.

Table III *(Concld.)*.

(a) PUBLISHED AT CALCUTTA.—*Concld.*

5. Map Publication and Office work Report, 1931-32. (230).
6. Survey of India Notes,—issued monthly. (2,750),
7. List of Maps published,—issued monthly. (4,400).
8. List of F. O. U. O. Maps published,—issued quarterly. (4,000).
9. Government of India and Circular Orders. (2,000).
10. Correction slips to Handbooks of Topography, Border Specimen, Map Catalogue, &c. (37,493).
11. Rules for the guidance of Officers conducting Class II Service Examinations of the Survey of India. (400).
12. Rules to be observed in the Examination of the candidates for Class II Service of the Survey of India. (400).
13. Miscellaneous. (182).
14. Calendars for 1934. (1,150).

(b) In hand at Calcutta.

1. *Handbook of Topography Chapter V (4th Edition).*
2. *Index to Annual Reports of the Survey of India, 1904-05 to 1926-27 compiled by Lt.-Col. A. H. Gwyn, I.A.*
3. *Price list of maps.*
4. *Corrections to Handbooks of Topography, Conventional Signs, &c.*
5. *Government of India and Circular Orders.*
6. *Booklet of Conventional Signs for use on Plane Table Sections.*
7. *Catalogue of the Survey of India Maps.*

(c) PUBLISHED AT DEHRA DŪN.

1. Geodetic Report Volume VIII. (300).*
2. Handbook of Topography Chapter XII, Air Surveys. (330).
3. Annual Provision and Maintenance Returns of 46 Districts. (1,725).
4. Secondary Levelling Pamphlets, gestetnered. (1,900).
5. Triangulation Pamphlets. (300).
6. Record Volume No. XXIV (Riverain Surveys in the Punjab, 1901-1929). (500).
7. Tide Tables for the Indian Ocean, 1934. (1,500).
8. Tide Tables, Hooghly River, 1934. (150).
9. Do. Hooghly (Signals, lights, &c.) 1934. (800).
10. Do. Rangoon, 1934. (850).
11. Do. Bombay, 1934. (1,000).
12. Report on the Geodetic Work of the Survey of India, 1930-33. (1,400).
13. Addenda to Levelling Pamphlets. (1,425).
14. Correction slips to Handbooks and pamphlets, &c. (8,095).
15. Lists of Bench Marks. (20).
16. Miscellaneous and professional forms. (220,711).

(d) In hand at Dehra Dūn.

1. *Geodetic Report, 1933. (350).*
2. *Levelling Pamphlet No. 40. (100).*
3. *Addenda to Levelling Pamphlets Nos. 45 and 53. (365).*
4. *Triangulation Pamphlets. (500).*
5. *Addendum to Triangulation Pamphlets 35 A, B, E and F and 34 D, G & H. (910).*
6. *Tide Tables for the Indian Ocean, 1935. (1,400).*
7. *Record Volume No. XXV (Surveys in Swāt, Chitrāl and Gilgit). (200).*
8. *Annual Provision and Maintenance Return of 1 District. (25)*
9. *Miscellaneous and professional forms. (57,595).*

120. Map Issues.—From Table IV below it will be seen that the total sales by the entire Department during the year were 570,331 copies, valued at Rs. 2,36,324, as against 540,635 copies, value Rs. 3,10,456 sold during the previous year.

The Map Record and Issue Office's total departmental sales were 130,491 copies, value Rs. 1,39,694. This represents a decrease of 54,060

* Numbers in brackets after each item denote the number of copies printed.

copies on the previous year's figures. This decrease is mainly due to the fact that issues to the Army and the Royal Air Force fell by 43,916 copies; the public, too, purchased 15,667 copies fewer. Sales to Government Officials, however, increased by 5,523 copies.

The total number of Extra-Departmental maps issued by the Map Record and Issue Office was 383,266 or 145,236 copies more than last year. Of this number, Government Departments, including the Army and the Royal Air Force, purchased 149,622 copies more than last year. The sales of these maps to the general public, however, decreased by 4,386 copies.

As the result of the strictest economy, the issue of complimentary copies by Map Record and Issue Office fell from 14,031 to 12,753 or 1,278 copies less than the previous year.

The number of maps transferred to the High Commissioner for India and the Circle Offices for stock and issue were 37,084 copies, value Rs. 57,960.

Table IV.—Maps issued by Survey units.

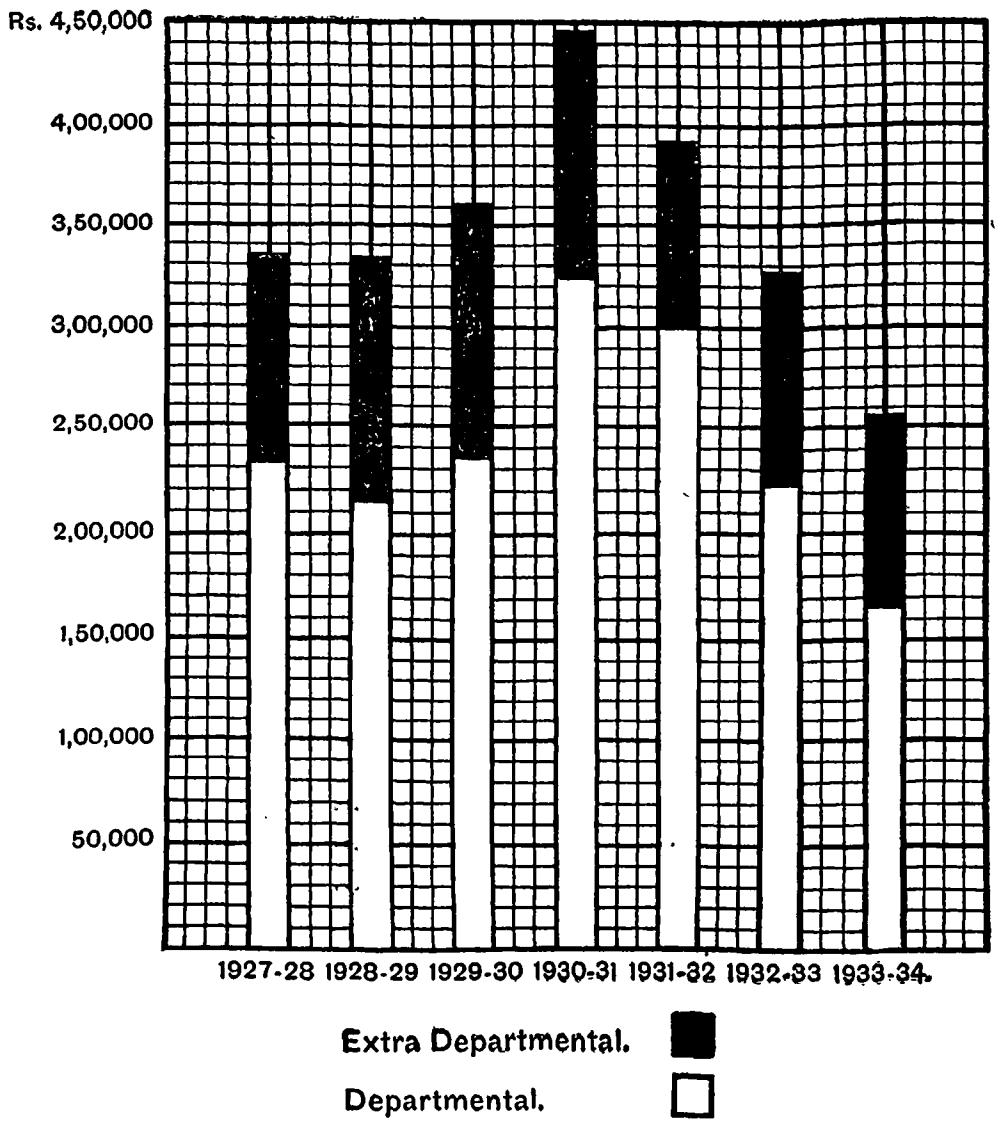
D=Departmental. X=Extra-departmental.		SALES.								FREE ISSUES.
		Government Officials.		Army and Royal Air Force.		Public.		Total		
		Number of copies.	Sale Value. Rs.	Number of copies.	Sale Value. Rs.	Number of copies.	Sale Value. Rs.	Number of copies.	Sale Value. Rs.	Number of copies.
Calcutta	D*	23,355	25,324	81,967	78,461	25,169	35,909	130,491	1,39,694	12,753
	X	306,872	28,825	14,202	5,624	62,192	17,045	383,266	51,494	1,248
Dehra Dūn & Mussoorie	D	4,916	5,518	4,702	4,252	651	1,049	10,269	10,819	7,361
	X	21,095	11,125	1,100	543	2,336	4,000	24,531	15,668	66
Simla	D	279	573	.....	.....	153	321	432	894	503
	X	.....	.....	.....	.....	.....	.....	.....	.....	.....
Murree ("A" Company)	D	2	5	198	308	39	71	239	384	.....
	X	.....	.....	.....	.....	.....	.....	.....	.....	.....
Quetta ("E" Company)	D	182	359	4,839	6,625	8	15	5,029	6,999	172
	X	1,964	423	4,478	1,533	1,100	94	7,542	2,050	.....
Risalpur Cantonment (No. 18 Party)	D	.....	.....	.....	.....	.....	.....	.....	.....	3,647
	X	.....	.....	4,158	1,410	.....	.....	4,158	1,410	.....
Bangalore	D†	1,367	2,223	282	482	1,328	2,252	2,977	4,957	558
	X	.....	.....	.....	.....	.....	.....	.....	.....	.....
Shillong	D	125	227	207	204	220	376	552	807	1,120
	X	.....	.....	.....	.....	.....	.....	.....	.....	.....
Maymyo	D	378	559	269	274	198	315	845	1,148	398
	X	.....	.....	.....	.....	.....	.....	.....	.....	.....
Totals	...	360,535	75,161	116,402	99,716	93,394	61,447	570,331	2,36,324	27,828

*In addition to above, 37,084 copies of maps, value Rs. 57,960, were issued by the Map Office, Calcutta, to the High Commissioner for India, the Survey Circles and Parties, for stock and sale.

†These figures are the sales of 2 years. By an oversight the sales made by the Agent, Mr. Clarke, in 1932-33 were not reported last year and they are, therefore, included now.

PROGRESS OF MAP SALES

1927—34.



The above diagram represents the aggregate sales of the whole Department.

121. Map Record and Issue Office.—Notwithstanding the general depression, the volume of work in the Map Record and Issue Office has remained constant. Whereas large orders in single indents were customary in years gone by, a larger number of smaller, separate indents are now the order of the day. The general clerical labour, therefore, of registering letters, handling maps, posting loose-leaf ledgers, drawing up invoices, bills, etc., shows no diminution. Actually in 1931, 15,371 letters were received, in 1932, 15,423, and in 1933, 15,414.

Excluding the value of maps held by the Circle Offices, the approximate value of the Map Record and Issue Office stock on 31-3-34 including those stocked in the Branch Office, Calcutta, was Rs. 34,85,173.

Verification of stock by a separate section of the Map Record and Issue Office was carried out at frequent intervals throughout the year, and revealed only a few negligible discrepancies.

All receipts were brought to account at Catalogue prices. No revaluation took place of stocks already in hand.

It is the business of this office not to be caught 'out of stock' of any of its catalogued maps. With this object in view, every precaution is taken to decide on the size of each edition of every individual sheet, so that a reprint may be deferred for as long as possible. Nevertheless, it sometimes happens that a sudden large and unexpected demand upsets all calculations. This necessitates a reprint, usually with corrections to date and the consequent scrapping of old stock.

In the long run, therefore, it is always found to be far more economical to be slightly overstocked, than be caught out of stock of any published sheet. The present stocks are justified by past experience and present requirements.

34,859 superseded copies of 335 different maps were removed from stock, of which 3,509 copies were sold at a nominal value to the Bengal and the Bihār and Orissa Drawing Offices for Departmental use, and the remaining copies were scrapped. This averages 94 copies per superseded map or $11\frac{1}{8}\%$ of the total receipts (280,699 copies) during the year.

As in past years, the Army still continues to top the list of purchasers. From a classification of issues, it is found that the percentages of departmental sales roughly work out as below :—

ARMY	63%
PUBLIC	19%
OTHER GOVT. DEPTS. ...	18%

BĀRA FORT, KAJŪRI PLAIN, NORTH WEST FRONTIER.
Reproduced from a water colour painting by Lieut. R. H. Sams, B.Sc., R.E.

Table V. Stock of Maps. This table gives the stock of maps as it stood on 31st March 1934.

Class of maps.	CALCUTTA.				DEHRA DÚN.		SHILLONG.		SIMLA.		FEROZEPORE AND MUBREE.		QUETTA.		MAYMYO.		BANGALORE.		TOTAL.	
	M. R. I. O.		BRANCH AGENCY.																	
	Number of copies in stock.	Present Face Value Rs.	Number of copies in stock.	Present Face Value Rs.	Number of copies in stock.	Present Face Value Rs.	Number of copies in stock.	Present Face Value Rs.	Number of copies in stock.	Present Face Value Rs.	Number of copies in stock.	Present Face Value Rs.	Number of copies in stock.	Present Face Value Rs.	Number of copies in stock.	Present Face Value Rs.	Number of copies in stock.	Present Face Value Rs.	Number of copies in stock.	Present Face Value Rs.
1/2M Southern Asia Series ...	9,856	21,738	14	33	150	374	...	...	53	132	37	90	58	116	...	...	29	74	10,197	22,558
1/M India and Adjacent Countries ...	36,110	58,882	210	341	1,463	2,431	147	220	321	499	158	245	294	441	331	497	447	740	39,481	64,296
1/M Carte Internationale du Monde	4,292	8,770	8	16	113	226	50	100	47	94	11	33	18	45	...	...	47	141	4,586	9,425
Two-inch maps	11,029	31,934	...	...	7,815	16,133	351	623	...	...	...	...	...	...	...	...	...	...	19,195	48,690
One-inch maps	1,275,723	19,18,974	4,254	6,209	48,617	72,884	24,324	35,980	2,508	3,800	3,866	5,876	1,538	2,288	22,163	31,722	3,931	5,818	1,586,924	20,83,501
Half-inch maps	380,087	7,56,886	1,036	2,034	12,078	23,838	6,104	12,033	682	1,372	980	1,989	793	1,493	3,798	7,596	1,193	2,346	406,751	8,09,587
Quarter-inch maps	267,844	3,90,219	620	808	7,683	10,794	3,355	4,811	1,019	1,555	918	1,396	1,163	1,713	2,732	4,101	512	623	285,746	4,16,020
General maps of India ...	18,061	54,694	79	165	377	489	64	204	51	141	9	17	11	20	...	...	56	203	18,708	55,933
Provincial and District maps of India	5,682	22,387	25	84	332	840	659	1,141	36	126	11	32	...	...	15	25	41	225	6,801	24,858
Cantonment and Town maps (Special and Guide).	51,900	1,32,653	49	122	10,421	21,054	352	750	503	1,725	225	564	31	127	147	429	512	1,074	64,140	1,58,496
Manœuvre and Radius maps ...	5,994	11,597	10	26	123	266	...	...	22	51	110	190	...	...	121	194	...	...	6,380	12,324
Miscellaneous maps	79,624	86,441	73	160	6,343	6,923	280	516	576	918	22	60	22	40	...	...	27	27	86,967	95,085
TOTALS ...	2,146,302	34,75,175	6,378	9,998	95,515	1,56,252	35,586	56,328	5,818	10,412	6,347	10,492	3,928	6,283	29,307	44,562	6,795	11,271	2,335,876	37,80,773

XII.—WORK OF DRAWING OFFICES.

122. Tables VI to VIII give an abstract of new maps, reprints and new editions completed for publication as well as those in hand during the year, for the whole department.

123. No. 1 Drawing Office, Calcutta.—The preparation of a revised edition, both political and layered, of the 32-mile map of India and Adjacent Countries has been taken in hand. The map will be brought up to date and, as it is intended for use as a wall map, the details and lettering will be in bold style.

Province maps, generally on the 1/M scale, in new style for use as wall maps, are in hand. Two of these maps for the United Provinces and the Punjab are in press.

124. No. 2 Drawing Office, Dehra Dūn.—The mapping taken over from No. 3 Drawing Office, on the abolition of the Central Circle has since been completed. The 8-mile map of Nepāl, which is to replace the preliminary edition published in 1928 has been submitted for publication.

The new method adopted for the revision of Sheet No. 63 E/14 from air photographs, as described in the report for 1932-33, has proved very satisfactory in saving time and labour.

Forty-two one-foot contour charts out of the ramaining 43 charts for the Bahāwalpur area of the Sutlej Valley Project were completed and sent for publication to "E" Company, Quetta. One chart was subsequently omitted from the programme, not being required by the Punjab Irrigation Department.

Triangulation records of Persia and Mesopotamia since 1920 were received from the Computing Office, arranged and indexed.

125. Forest Map Office, Dehra Dūn.—This office continues to meet all demands from Local Governments, except Assam, Bihār and Orissa for Forest maps. Its main work was the fair drawing of working plans and new editions for various forest officers and upkeep of their office copies; in addition 26 sheets, comprising working plans and 4-inch enlargements were prepared for Bastar, Jawhār and Kashmīr States and a small scale map of Cutch on urgent requisition for the Maharao of Cutch.

126. Map Record and Business Section.—This section continues to be responsible for the storage, dispatch and sales of publications and forms, and the collection of bills for all supplies and extra-departmental work carried out by the Geodetic Branch. It stores all originals of Cantonment and Forest maps with their published prints and carries a stock of Survey of India maps for issue within the department and sale to the public.

127. No. 6 Drawing Office, Simla.—*Survey Section.* The following work was done in addition to that reported in Tables V to VII:—

Indexes.—A large number of miscellaneous indexes were prepared.

General.—(*a*) The Frontier Circle records were received, arranged and indexed.

(*b*) A certain amount of reorganization has been found necessary, especially in the office copy and record sections. In the latter, new registers of records are under preparation with cross references to enable original records to be more easily traced when required.

Army Section.—(*1*) The Army Section was employed in the preparation of maps etc. for the Army and the various Government Departments. Details of this work will be found in the confidential supplement 1932-33.

(*2*) During the past few years there has been a steady increase of work from all departments. The section is now being equipped with up to date power machinery capable of meeting with urgent demands, and it is hoped, that this will improve the efficiency of the section, both as regards increased output and quality of work.

Table VI.—New maps.

Figures in italics denote work in hand.

	TOPOGRAPHICAL.				GEOGRAPHICAL.								GENERAL AND SPECIAL.						ACCESSORY.			MISCELLANEOUS.				OFFICE COPIES.	
					1/M.		Carte Internationale.		1/2 M.																		
	1-inch.	½-inch.	¼-inch.	½-inch.	Helio.	Engraved.	Helio.	Engraved.	Helio.	Engraved.	Guide Map.	District.	Province.	India.	Forest.	Cantonment.	Gridding.	Shading.	Colour Patterns.	Indexes.	Charts.	Various.	New.	Old, corrected.
No. 1 Drawing Office including Engraving Office.	...	*8*	...	...	...	*1*	...	...	1	3(a)	...	1(a)	9(b)	...	3(c)	1	7(a)	10(d)	...	...	...	...	8(e)	...	2(f)	...	...	...	...	152	*4*	181	*62*	58	*3*	7	...	...	...	23	*7*	426	5,133
No. 2 Drawing Office ...	3(g)	8(g)	5	...	6	*24*	1(h)	3(4)	...	7(j)	...	...	...	...	*2*	...	...	...	3(k)	...	...	...	...	...	1(m)	...	...	...	...	8	...	...	...	29	7	17	1(n)	8	*11*	22	...	70	321
Geodetic Branch Parties ...	7	...	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	27(0)	28 (m)	...	...	...	...	...	...	...	...	...	...	...	...	...	...
No. 5 Drawing Office ...	...	...	13	*14*	3	*10*	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	2(e)	10	...	...	...	81	5	...	...	...	...	...	...	92	618
Eastern Circle Parties ...	43	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
No. 6 Drawing Office ...	...	...	2	*2*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	*2*	...	...	30	*10*	...	...	...	...	...	...	79	3
Frontier Circle Parties ...	17	*27*	3	*2*	...	*1*	...	...	...	...	...	...	...	...	...	...	*2*	*1*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
No. 6 (S. I.) Party ...	18	...	10	*9*	8	*1*	...	...	...	...	...	...	...	...	...	...	...	2(p)	...	...	...	...	...	...	...	1	...	...	10	...	...	...	44	*2*	...	...	...	...	...	...	73	406
No. 10 (Burma) Party ...	12	...	6	*6*	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	35	...	...	...	...	...	290	...	179	103
Forest Map Office ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	27	*7*	361	636
Total ...	97	*43*	45	*33*	20	*37*	1	*3*	1	*10*	...	*14*	...	...	3	...	*4*	1	*1*	4	6	...	...	8	1	3	1	...	27	*28*	189	*6*	181	*62*	277	*27*	24	*1*	8	*11*	362	*14*	1,283	7,310
Total to date ...	3,593		1,045		347		.....		54		27		1		19		1		16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total for India ...	6,218		1,630		450		.....		104				41				22			.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

References.

Scales :—*x*-**inch** means *x* inches to 1 mile.

x-**mile** „ 1 inch to *x* miles.

1/M means 1 : 1 million or 1·014 inches to 16 miles.

1/2M „ 1 : 2 „ „ „ „ 32 „

(*a*) Revised editions, new compilation.
(*b*) Includes five revised editions.
(*c*) „ one „ edition.
(*d*) Calcutta & Howrah, 3″ = 1 mile.
(*e*) Baluchistán, Bengal, Hyderábád, Kashmír and Jammu, Mysore & Coorg, U. P. and Delhi, Burma, and Punjab.
(*f*) 32-mile & 128-mile India, (engraved edition).
(*g*) Includes six revised editions from air photographs and five new editions from two-inch surveys.
(*h*) Applique slip to Sir A. Stein's 8-mile map No. 2 of Chinese Turkistán and Kansu.
(*i*) Special Nepál maps.
(*j*) Including four revised editions.
(*k*) Bombay, Delhi and Lucknow.
(*l*) 64-inch thirteen sheets and 16-inch fourteen sheets.
(*m*) „ three „ „ twentythree sheets.
(*n*) Revised edition. (Himálayas and Central Asia).
(*o*) Surveys and explorations, Himálayas and Central Asia.
(*p*) Gulbarga and Warangal.
(*q*) Office copy corrections for Govt. Officials and Military.
(*r*) 16-inch and 32-inch Shillong.

Table VII.—Miscellaneous.

No. 1 Drawing Office—

Originals corrected against press order proof	...	31
Mosaics (congregated rough maps prepared for photography)	... ...	79
Grid originals scrutinized and corrected ...	...	80
Grid cutting lines on originals drawn or checked	...	102
Shaded originals corrected and emphasized	...	41
Miscellaneous cases	...	322

No. 2 Drawing Office—

Mosaics (Congregated rough maps prepared for photography)	...	8
Exploration Krab files (rough indexes prepared)	...	42
„ „ (fair „ „)	...	10
Party sheets examined, corrected and submitted for publication	...	13
Miscellaneous cases	...	130
Published charts and indexes corrected by hand	...	2,738

Forest Map Office—

Standard indexes completed	...	31
Sheets coloured for indents	...	148
Area extracted No. of sheets	...	16
Originals corrected ...	...	24
No. of sheets passed for publication	...	57

No. 6 Drawing Office—

Sheets examined, corrected and submitted for publication	...	19
Guide Maps examined, corrected and submitted for publication	...	2

No. 10 (Burma) Party—

Map mounting (Booklets)	...	321
Gridding sheets for Military training ...	...	50
Mosaics (congregated rough maps prepared for photography)	...	6
Trigonometrical data supplied to Govt. officials	...	8

Table VIII.—Re-issues.

Reprints—No changes in map. New editions—Slight alterations. Revised editions—Considerable changes.

	MODERN MAPS INCLUDING PRELIMINARY EDITIONS.								OLD-STYLE, INCLUDING PROVISIONAL ISSUES.			GENERAL AND SPECIAL.					
	TOPOGRAPHICAL.				GEOGRAPHICAL.								RAILWAY.	FOREST.	CANTONMENT.		
	1-inch.	½-inch.	¼-inch.	¼-inch.	1/M. Helio.	1/M. Engraved.	1/M. Carte Internationale.	1/2 M.	1-inch.	½-inch.	¼-inch.	Various.	67-mile.	2-inch & 4-inch.	12-inch.	16-inch.	64-inch.
No. 1 Drawing Office including Engraving Office—																	
Reprints	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
New editions	57	15	18	...	1	2	1	...	12	...	6	6	1	...	...	...	...
Revised ,, ...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...
No. 2 Drawing Office—																	
New editions	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Reprints	...	...	...	6	...	...	...	...	...	...	...	1	...	...	...	...	...
No. 6 (S. I.) Party—																	
New editions	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Revised ,, ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
No. 5 Drawing Office—																	
New editions	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1
Revised ,, ...	...	...	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...
No. 6 Drawing Office—																	
New editions	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Revised ,, ...	...	4	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...
No. 10 (Burma) Party—																	
New editions	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Revised ,, ...	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Forest & Cantonment Office—																	
Reprints	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
New editions	...	...	...	...	...	...	...	...	...	...	...	...	...	24	...	...	...
Revised ,, ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Totals ...	**60**	**20**	**23**	**6**	**3**	**2**	**2**	**...**	**12**	**...**	**6**	**7**	**1**	**24**	**...**	**...**	**1**

XIII.—PRINTING AND MISCELLANEOUS.

128. The Photo.-Litho. Office, Calcutta.—The complete plant of 4 rotary offset machines, 9 flat-bed machines and 20 presses has been in almost continuous commission during the year. Machines have been overhauled as work permitted.

New equipment added during the year includes a single line engraved screen 40″ × 32″ — 85 lines per inch, — a second McLeod Bar and 3 sets of Penrose Empire Arcs. The new screen was manufactured by Messrs. T. E. Brown & Co. Ltd., Leicester, to the order of Messrs. Hunter Penrose Ltd. Lines are parallel to the longer edge of the glass. Its use will increase the range of possible colour combinations for large tinted maps and will reduce costs in such cases by reducing the number of necessary machine printings. The second McLeod Bar will enable both offset presses to be employed simultaneously on lithographic combination for the quicker supply of fair-drawing material from survey plane-table sections. The arc lamps replace now inefficient old plant purchased in 1922. Improvement in collodion and powder negatives is expected with a decrease in consumption of electricity.

A bank-post paper has been adopted for offset printing. It has the merit of being tough and durable, is cheaper than the rag litho paper which has to be used on flat-bed machines and gives an equally good printed result.

A process has been developed for printing down an engraving pattern on copper. The conception is no new one and experimental patterns have been made previously by powdering a positive image printed down on copper by the normal powder process. By this method, a positive had first to be prepared from a negative of the subject, and to prevent oxidisation of the copper, the pattern had to be varnished. By the new process, a negative is printed down on copper coated with a slightly thicker albumen solution than is normally used for helios. After an exposure of about 15 minutes in sunlight, the copper plate is placed in a dye bath. A positive image in clear copper develops against a background of dyed unexposed albumen which is partially hardened and is not soluble in the bath. The pattern does not tarnish.

The possibilities of correction of distortion in photography have again been explored. Full exploitation of lithographic combination on the offset presses awaits a solution to this problem, as work cannot be combined which has been found impossible to photograph to correct dimensions in the studio in the first place.

COST AND OUT-TURN OF PHOTO.-LITHO. OFFICE.

Expenditure.	Value of out-turn at office rates.	Negatives prepared.	Zinc plates prepared.	Maps printed.		Impressions pulled.
				Departmental.	Extra-departmental.	
Rs.	Rs.					
3,07,802	3,73,396	5,615	7,262	847	3,029	3,375,571

INDEPENDENT OUT-TURN OF THE PROCESS ENGRAVING AND TYPE PRINTING SECTIONS.

PROCESS ENGRAVING SECTION.					TYPE PRINTING SECTION.		
HALF-TONE WORK.		LINE WORK.		PHOTO-GRAVURES.			
Blocks prepared.	Impressions pulled.	Blocks prepared.	Impressions pulled.	Plates prepared.	Items or pages published.	Copies printed.	Impressions pulled.
41	14,460	32	12,720	6	1,925	673,262	1,317,182

129. OUT-TURN OF ENGRAVING OFFICE COPPER PLATE PRINTING SECTION.

IMPRESSIONS PULLED.				
Photogravures.	Chromo Paper.	Transfer.	Miscellaneous.	Total.
2,769	369	208	4,077	7,423

130. Photo.-Zinco.-Section, Dehra Dūn.—The printing plant of this section consisting of one rotary and one flat-bed machine*, an offset Press and 3 hand presses, was in continuous operation during the year, printing cantonment and forest maps, diagrams, the Bhakra Dam Project Sheets, and indexes and charts, for the Geodetic Report as shown in Table 1 (*b*).

The plan boards and camera backs which had developed a good deal of uncontrolled play were reconstructed to ensure accurate focussing to dimensions.

Two large racks for the storage of negatives were made.

One new double demy plate graining machine was received from England to replace the existing old one.

One double elephant litho. hand Press was sent to No. 18 Party (F. C.) at Risalpur.

131. No. 18 (Air Survey) Party, Murree and Risalpur.—The reproduction section was employed on miscellaneous work throughout the year.

Three special maps for Headquarters, Northern Command, were prepared and printed rapidly in Murree in August under difficult conditions occasioned by the absence of electricity and heavy monsoon conditions.

Experimental work on the preparation of colour filters was carried out and a working method of direct separation of two colour originals by photographic contact printing, suitable for use in the field, was finally evolved. Improvements on the method are now under investigation.

*There are two flat-bed machines, but owing to retrenchment of personnel only one can be operated at a time.

132. 'E' Company, Quetta.—The reproduction section was employed on miscellaneous work mostly on spot level charts for the Irrigation Department of the Punjab.

Reproduction of originals received :—

In one colour	178
In two colours	27
In three ,, ...	50
In four ,, ...	3
TOTAL ...	258
Vandyke and helio plates prepared	384
Prints pulled	20,893

XIV.—MATHEMATICAL INSTRUMENT OFFICE.

133. The year under review has been an exceedingly gloomy one for the M. I. O., our orders both for repairs to instruments and for new supplies having fallen considerably. The total value of the repairs to instruments for the Military Department has dropped to about one-third, due in part to very few instruments having been sent for repair, and in part to the great difficulty experienced in passing those repaired through the Inspection Department. We hope however that this inspection difficulty has now been overcome, *vide* para. (*b*) below, last sub-para.

The following special repair work was carried out in the M. I. O., besides the special manufactures detailed below:—

(*a*) Repairs of—

300 Binoculars.
600 Monoculars.
10 Clinometers.
26 Directors.
12 Stand directors.
85 Prismatic and pocket compasses.
126 Rangefinders.
33 Sight dials.
20 Telescopes.
64 Watches.
3 Colorimeters.
69 Microscopes.
1 Opthalmoscope.
1 Refractometer.

Manufactures of—

4 Clinometers adapted to read from both ends to facilitate bubble setting.
15 Sounding chains, 60 ft.
1 Topographical trailer tape, heavy pattern, ·625″ wide.
3 Callipers duralumin (one 14″ and two 26″).
1 Scale ivory for plotting ship's position.
2 Waterfinders.
1 Apparatus testing aneroid barometer complete.
80 Sets of brass hydrometers pocket, complete with thermometer and test glass.
1 Tape steel 20 yds. divided yards and 10ths.
1 Rule, one metre long, for optical bench.

A tilt indicator recorder for F.8 camera designed by Capt. Crone was constructed and despatched to O. C. No. 18 (Air Survey) Party.

The object of the recorder is to photograph two small portions of the horizon at the same time and on the same negative as the vertical photograph.

(*b*) The optical manufacture department shows an increase in the manufacture and repair of lenses and prisms on the previous years. During the year under review 184 binocular prisms were manufactured and 4207 prism surfaces reworked, polished and refigured. In regard to lenses 198 were manufactured, 559 reworked and repolished and 1572 rebalsalmed. Other optical components manufactured were—

Theodolite diaphragms	...	118,
Binocular graticules ...	...	593,
Mirror reflectors ...	...	167,
Agate knives for chemical balances		16.

Optically flat stainless steel mirrors for quintants and survey stereoscopes to the number of 39 were made up and the production of 295 range-finder moderating glasses with coloured sectors was completed. The manufacture of 390 cover and sealing glasses for liquid compasses was finished besides the usual manufacture of various mirror components. The graduation of glass jars for the Excise Department and rain measuring glasses for meteorological work totalled 385 over the year under review. Various instruments as follows were made up or repaired for Civil Departments of Government—

10 Barometers.
20 Hygrometers.
38 Planimeters.
473 Thermometers.
147 Hydrometers.
25 Survey stereoscopes.
21 Sphygmomanometers.
590 Compasses of sorts (repaired and adjusted).

The Inspector of Guns, Hastings and the Mathematical Instrument Office have carried out experimental work in regard to the conditioning of optical instruments, involving impregnation of the instruments and the introduction of Silica Gel containers. New testing apparatus was made up during the year, the more notable being a standard graticule collimator, auto-collimator for prism angles and parallel planes, cabinet with monochromatic illumination for interference test of optical surfaces, collimator for definition and pyramidal test of prisms and two standard burettes for rain gauge measure glasses.

The M. G. O. has agreed to have 300 pairs of binoculars fitted with the above Silica Gel containers and sent out for trial and we hope that this will solve the question of filming of binoculars, in which case the difficulty of inspection will cease and outturn would again become normal.

(*c*) Training given to extra-departmental personnel:—

At the request of the 'Iraq Government, Mr. Abdul Sattar Khalaf received training in the repairs of instruments for a period of six months, which terminated on the 21st May 1933.

(*d*) Monthly fire drill was held and the fire appliances inspected regularly.

(*e*) Army surplus and obsolescent instruments *viz.* binoculars, telescopes, &c., to the value of about Rs. 1,900 were sold, on behalf of the Director of Contracts, Simla, to the best advantage of Government. A sum of about Rs. 4,500 was realised from the sale of surplus and obsolescent stores and scrap materials belonging to the Mathematical Instrument Office.

(*f*) The following Officers visited the Mathematical Instrument Office:—

Major Suggate, Ordnance Mechanical Engineer, Allahabad Arsenal, in October 1933.

Major Bloor of Rawalpindi Arsenal with Serjeant-Major Bartlett on 9th December 1933 to discuss 3rd line repairs with the Superintendent, Mathematical Instrument Office.

The Institute members of the Mining and Geological Institute of India, 27 Chowringhee, Calcutta, on 22nd January 1934.

Lt.-Colonel R. Crofton, M.C., I.A.O.C., Assistant Director of Artillery, M. G. O. Branch, A.H.Q., on 25/26-1-34.

Members of the Ordnance Mechanical Engineers' Conference on 4/5-2-34.

Major F. J. Rice, M.C., R.A., Deputy Assistant Director of Artillery, M. G. O. Branch, A.H.Q., on the 9th March 1934.

Mr. Ram Chandra, C.I.E., M.B.E., I.C.S., Joint Secretary to the Government of India, Department of Education, Health and Lands, visited the Mathematical Instrument Office on the 22nd March 1934.

(*g*) Every effort has been made to reduce expenditure to the minimum and a saving of about Rs. 30,000 in the cost of establishments due chiefly to economy and short-time work is expected. Vacancies caused by retrenchments, deaths or discharges have not been filled up. The clerical staff has been reduced from 22 to 17, two posts having been transferred to the M. P. O. and three vacancies not filled up.

Expenditure on printing, stationery, stamps and books has been reduced as far as possible.

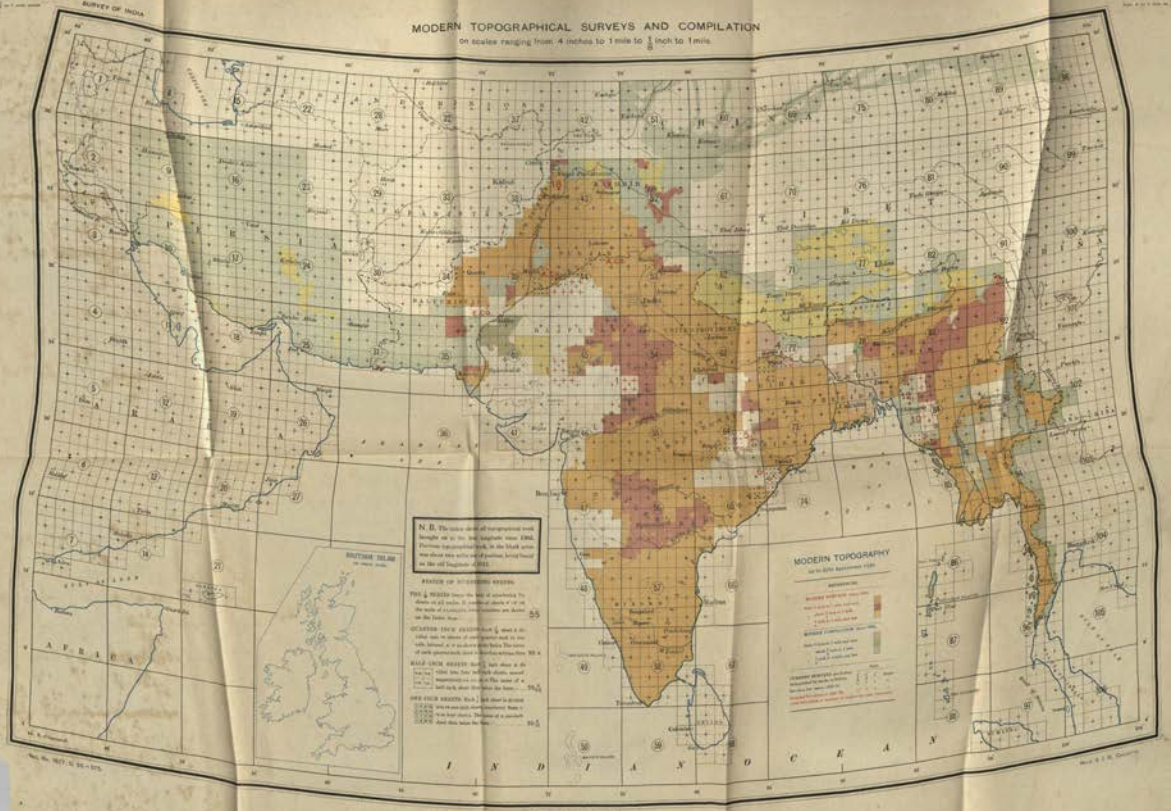
(*h*) Members of the supervising staff shared a large portion of responsibility of the work and carried on the work satisfactorily during the period of absence of Mr. A. Lacamp, Asstt. Superintendent for six months and 11 days, on leave.

134. The following comparative table shows a decrease in the demands on this office both for the supply of instruments and for repairs, which is due to the general trade depression.

	1931-32.	1932-33.	1933-34
	Rs.	*Rs.*	*Rs.*
1. Total value of stores issued ...	1,71,700	1,39,422	**1,93,785**
2. „ „ „ repairs carried out to orders	3,16,950	2,49,705	**1,30,648**
3. „ „ „ instruments &c. returned to stores	30,534	23,154	**14,203**
4. *Book value of stock in—*			
(*a*) Serviceable store	4,56,869	4,07,531	**3,66,279**
(*b*) Repairable „	1,44,197	1,59,494	**1,62,064**
(*c*) Material „	1,90,688	1,80,725	**1,65,131**
5. *Value of new instruments—*			
(*a*) Manufactured in workshop ...	85,065	44,105	**72,048**
(*b*) Purchased locally	16,222	13,264	**39,737**
(*c*) Imported through the Stores Department, London ...	36,085	8,410	**8,211**
6. Total value of work done in the workshop	4,89,189	3,52,141	**2,39,707**
7. Value obtained by sale of obsolescent and condemned stores ...	687	3,350	**4,919**
8. *Employees—*			
(*a*) Average numbers in workshop ...	438	424	**399**
(*b*) Cost of employees in workshop including pension contribution	1,89,812	1,55,898	**1,47,506**

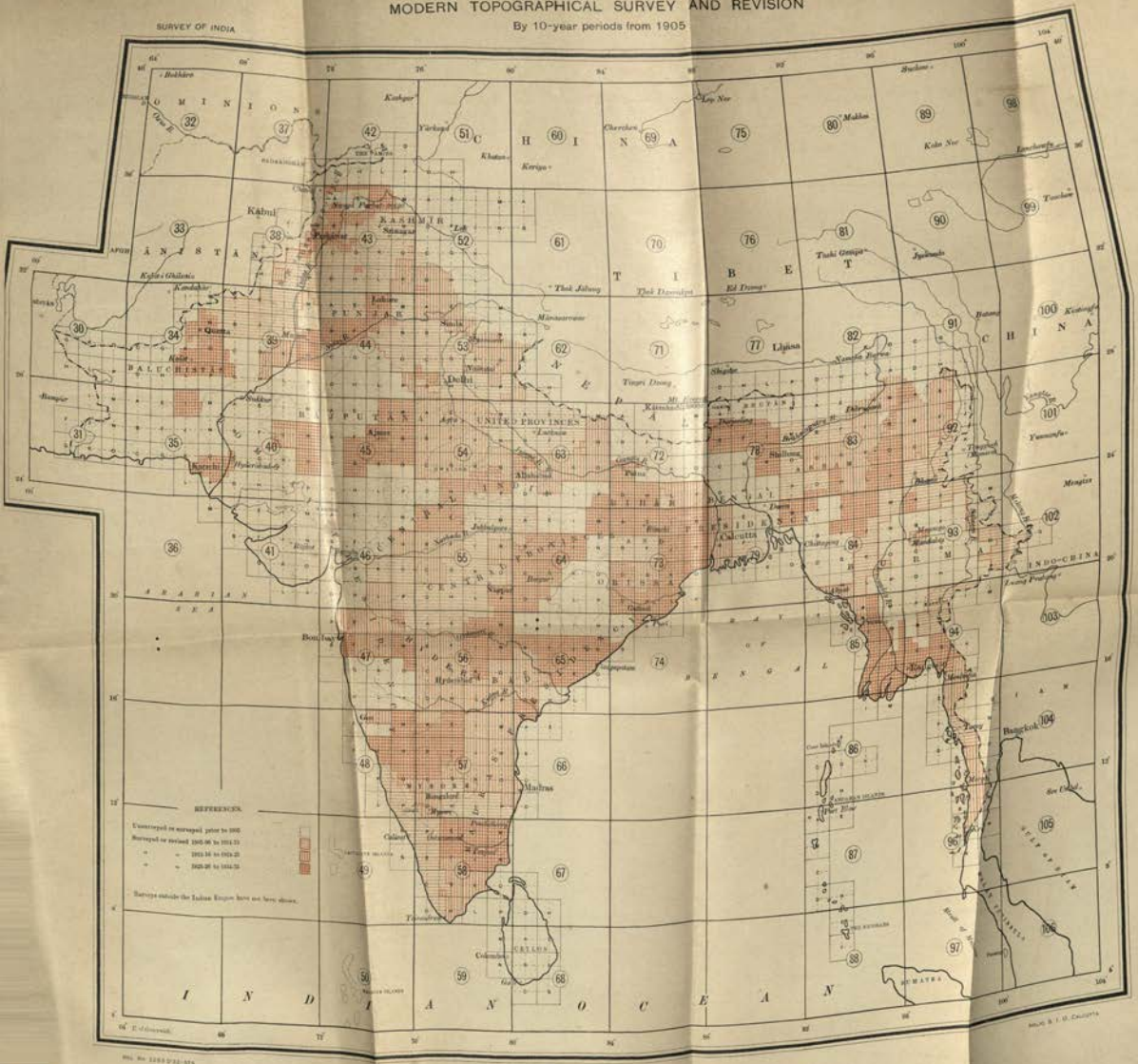
INDEX MAPS

1. Modern Topo. surveys and compilation ... ... *At End.*
2. Seasons of survey and revision ... ... „ „
3. Maps published on 1 inch and $\frac{1}{2}$ inch scales ... ... „ „
4. „ „ „ $\frac{1}{4}$ inch scale ... ... „ „
5. The India and Adjacent Countries Series, 1/M scale ... „ „
6. Carte Internationale du Monde, 1/M scale ... ... „ „
7. The Southern Asia Series, 1/2 M scale ... ... „ „


SURVEY OF INDIA
MODERN TOPOGRAPHICAL SURVEYS AND COMPILATION
on scales ranging from 4 inches to 1 mile to 1/8 inch to 1 mile.
N.B. The index shows all topographical work brought up to the date September 1942.
Previous topographical work, in the black areas, was almost entirely out of position, being based on the old Trigonometrical Survey.
REVISION OF EXISTING SURVEYS.
THE 1/4 INCH Series (near the west of Afghanistan) by sheets on old scales, 2 inches and 4 inches = 1 degree, on the scale of 1/4 inch to 1 mile. Outlines are shown on the Index Map.
QUARTER-INCH SERIES. Each 1/4 sheet is divided into 16 sheets of convenient size, to be referred to, as in sheets of the former series, by numbers, as shown on the Index Map.
HALF-INCH SERIES. Each 1/2 sheet is divided into four half-inch sheets, named respectively N.E., N.W., S.E. and S.W., as in the case of a half-inch sheet. Each sheet has been ... sq. miles.
ONE-INCH SERIES. Each 1/2 inch sheet is divided into 64 one-inch sheets, numbered from 1 to 64, as in the case of a half-inch sheet. The area of a one-inch sheet is about 90 sq. miles.
MODERN TOPOGRAPHY
up-to-date Revision 1939
REVISED TOPOGRAPHY (about 1940)
REVISED COMPILATION (about 1940)
Scale of Index 1:12 Million.
Published under the orders of Brigadier W. J. Cheesman, D.S.O., M.C., Surveyor General of India, 1942.
INDIAN OCEAN
AFRICA
ARABIA
PERSIA
INDIA
SOUTHERN ISLAND

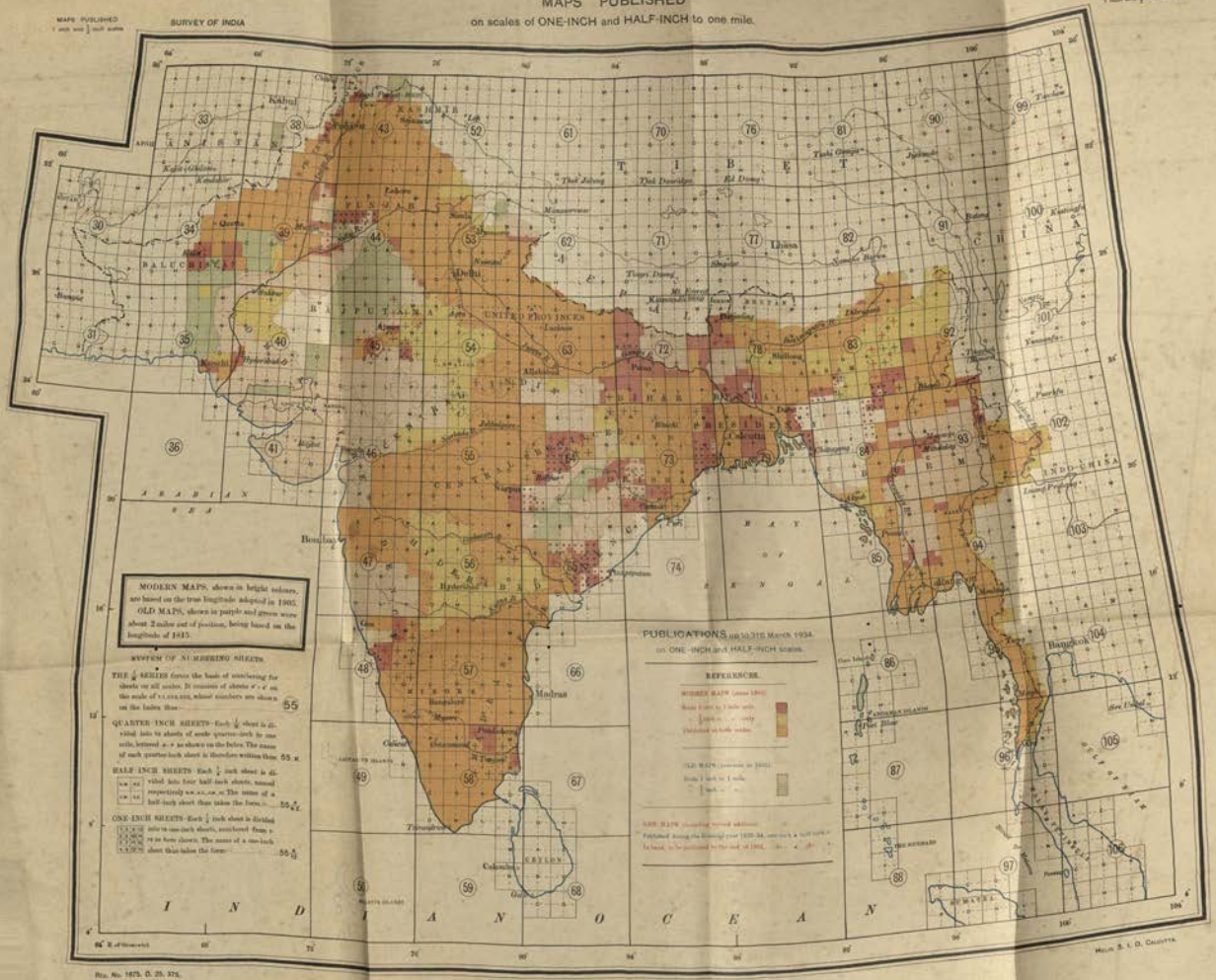
MODERN TOPOGRAPHICAL SURVEY AND REVISION

By 10-year periods from 1905


SURVEY OF INDIA
REFERENCES
Surveyed or revised 1905-06 to 1914-15
1914-16 to 1924-25
1925-26 to 1934-35
Surveys outside the Indian Empire have not been shown.
Scale of Index 1:12 Million
Miles 100 0 100 200 300 400 500 600 700 800 900 1000 Miles
Published under the direction of Brigadier H. J. Couchman, D.S.O., M.C., Surveyor General of India. 1934.

MAPS PUBLISHED
on scales of ONE-INCH and HALF-INCH to one mile.

SURVEY OF INDIA


MODERN MAPS, shown in bright colours, are based on the true longitude adopted in 1905.
OLD MAPS, shown in purple and green were about 2 miles out of position, being based on the longitude of 1815.
SYSTEM OF NUMBERING SHEETS.
PUBLICATIONS up to 31st March 1934.
on ONE-INCH and HALF-INCH scales.
REFERENCES.
Scale 1:12 Million.
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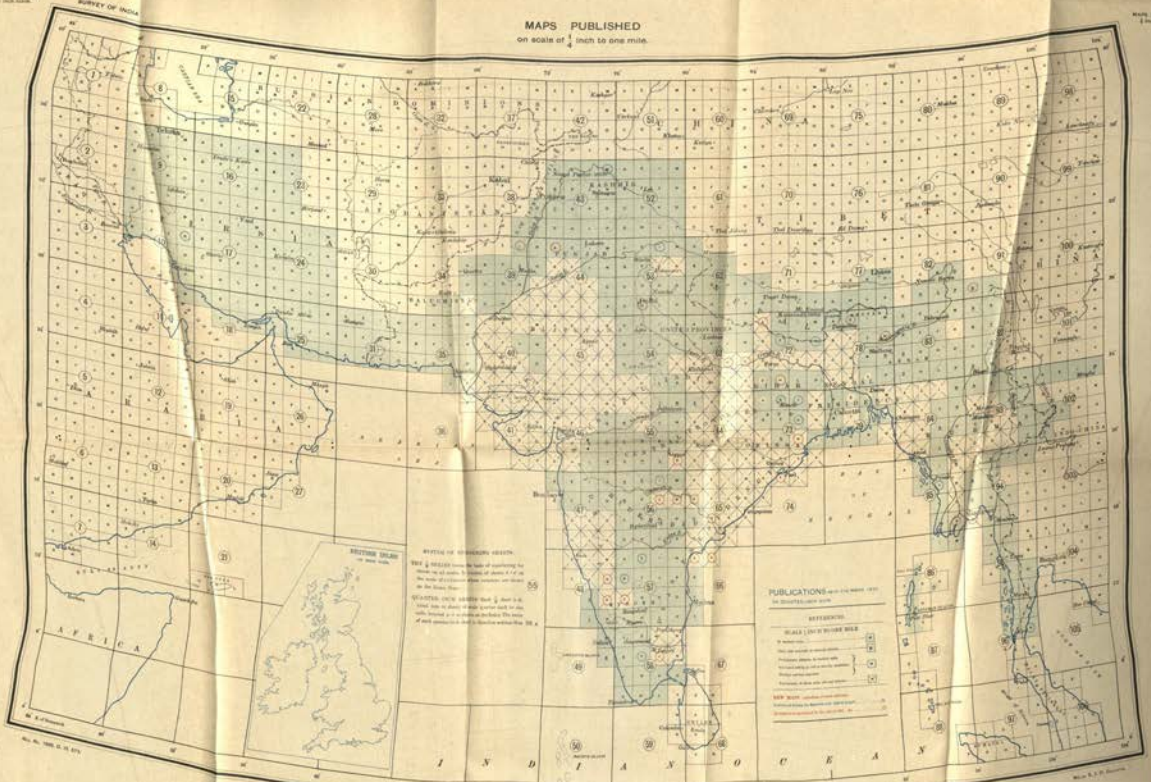

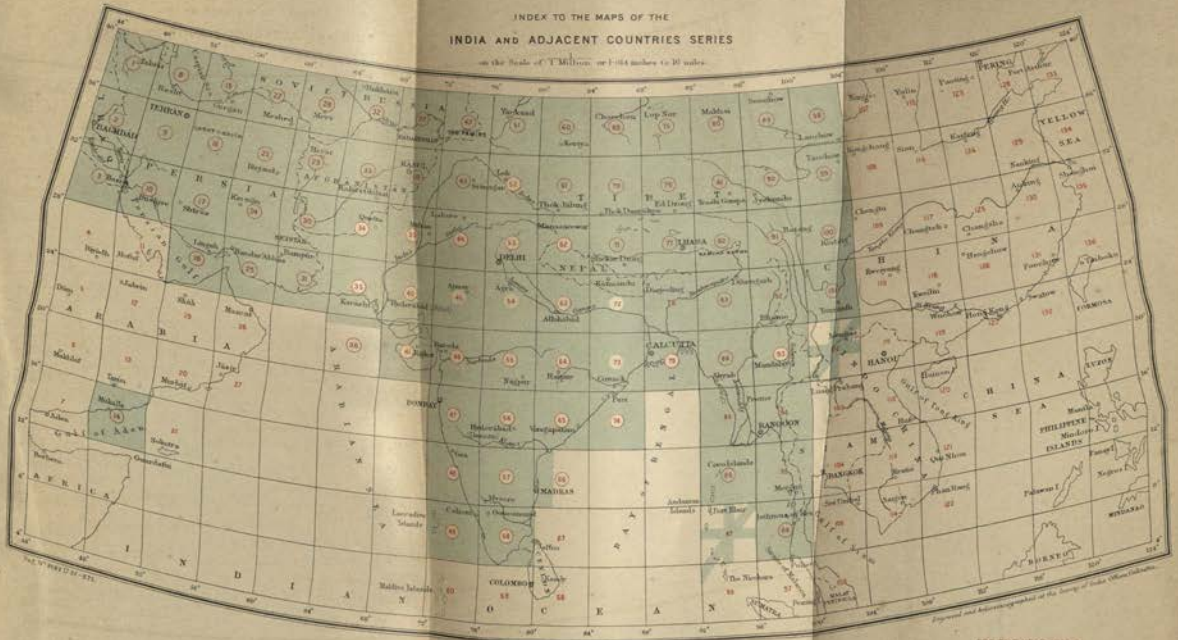
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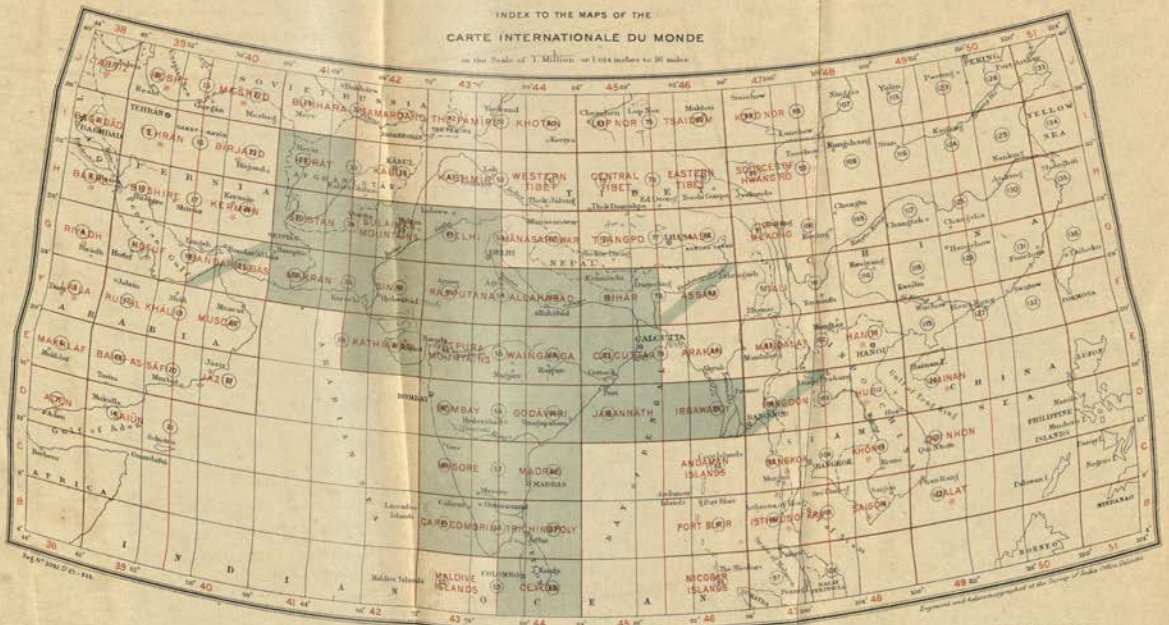

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